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Before the Storm: Water and Energy Utilities, Human Vulnerability and Disaster Risk

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Before the Storm: Water and Energy Utilities, Human Vulnerability and Disaster Risk

by

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DEDICATION

This dissertation is dedicated to my father, Rodger Bender. Although he is no longer here to read this work, he would be incredibly proud of me.

Additionally, I have been fortunate to be surrounded by a supportive and caring family, and I would like to dedicate this dissertation to Shirley Bender, Raul Velasquez and family, and Tina Caplette and family. You all kept me moving forward towards my goals and allowed me the time achieve them. I am eternally grateful to have you all in my life.

Finally, this is dedicated to the St. Thomas community, who showed me the meaning of resilience and perseverance in the face of adversity. Your strength is inspirational.

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TABLE OF CONTENTS

LIST OF TABLES v

LIST OF FIGURES vii

ABSTRACT x

CHAPTER ONE: INTRODUCTION 1
Setting: The Bridge to Nowhere 1
The Territorial Government's Bridge Project 2
Purpose for the Research 4
Contributions to Anthropology & Disaster Research 6
Research Objectives, Questions and Hypothesis 8
Overarching Research Topic 8
Research Objectives, Questions & Hypotheses 9
Dissertation Outline 11
Chapter Summary 13

CHAPTER TWO: LITERATURE REVIEW 15
Chapter Overview 15
Political Ecology 16
Political Ecology and Anthropology 16
Political Ecology and Development 20
Political Ecology of Water and Energy 22
Integrated Water Resource Management 24
Political Ecology and Energy 26
Authoritative Knowledge and Local Knowledge 28
Disasters and Anthropology 33
Assessing Vulnerability 33
Pressure and Release Model 38
Risk and Vulnerability 41
Risk Perceptions 41
Infrastructures and Anthropology 43
Building Back Better 44
Chapter Summary 46

CHAPER THREE: SETTING 48
Chapter Overview 48
St. Thomas Characteristics 48
Historical Periods 49
Pre-Colonial Period 49
Colonial Period 50

Post-colonial Period – Being a U.S. Territory 52
Disasters in the United States Virgin Islands 58
FEMA's Policies & Their Impacts 59
Historical Trajectory of Water, Wastewater, and Energy Development on St. Thomas 61
Energy Challenges & Sources 63
Water 64
Centralized Wastewater Treatment 65
Decentralized Wastewater Treatment on St. Thomas 65
Chapter Summary 69

CHAPTER FOUR: METHODS 71
Chapter Overview 71
Methodology 71
Participant Observation 74
Informal and Semi-Structured Interviews 74
Surveys 75
Focus Group & Participatory Mapping 76
Research Design 77
Research Questions 79
Sampling Strategy 81
Research Assistant 81
Semi-structured Interviews 81
Surveys 83
Demographics 85
Literature Review, Archives & Social Media 88
Participant Observation and Informal Interviews 89
Church Choir Focus Group 94
Participatory Mapping Activity 95
Analysis 96
Field Notes, Semi-Structured Interviews & Grey Material (Qualitative Data) 96
Surveys (Quantitative Data) 96
Presentation of Results 97
Ethics 97
Limitations 98
Chapter Summary 100

CHAPTER FIVE: RESULTS 102
Chapter Overview 102
H1: The USVI at a Cross Point Between Federal Policies & Practices and the Local Context 103
H2: Risk and vulnerability: infrastructures are seen as disconnected from historical, political, and social processes resulting in a less resilient community 114
Caribbean Institutional Perspectives: CARICOM's CCORAL Tool 114

FEMA & EPA Perspectives 116
VITEMA Hazards and Capability Assessments 118
H3 Authoritative and local knowledge continue to be disconnected within disaster planning and coastal resource management 120
Coastal Environment & Climate Change (LK) 120
Disaster Perceptions (LK) 127
Responsibility Questions: Disaster Planning, Coastal Environment & Climate Change 130
Participant Observations, Semi-structured Interviews, Focus Group & Participatory Mapping Results 137
A Note About the Non-Significant Chi-Square Tests 140
Additional Note About the Results 142
Chapter Summary 142

CHAPTER SIX: DISCUSSION 144
Chapter Overview 144
Hurricanes Irma & Maria, September 2017 144
H1: The USVI at a Cross Point Between Federal Policies & Practices and the Local Context 146
Water 148
Energy 150
Wastewater 154
H2: Risk and vulnerability: infrastructures are disconnected from historical, political, and social processes resulting in a less resilient community 156
H3 Authoritative and local knowledge continue to be disconnected within disaster planning and coastal resource management 159
Coastal Environment & Climate Change 159
Smith Bay and Water Bay Watershed Project 162
Disaster 164
Synthesis: Critical Assessment of the Post-Disaster "Building Back Better" Approach 168
Chapter Summary 174

CHAPTER SEVEN: CONCLUSION 176
Revisiting the Research Questions 177
Research Question 1 177
Research Question 2 177
Research Question 3 178
Contributions to Anthropology 179
Recommendations 180

REFERENCES CITED 184

APPENDIX A: KOBO SURVEY QUESTIONS 196

APPENDIX B: SEMI-STRUCTURED INTERVIEW SCRIPT 205

APPENDIX C: IRB APPROVAL LETTER 208

LIST OF TABLES

Table 1. St. Thomas Census (2000) Ethnicity, Race and Ancestry Count 54

Table 2. Research Questions and Data Collection Methods 80

Table 3. Interviewees Sampling 82

Table 4. Description of Survey Locations & Respondents 84

Table 5. Area of Residence & Years of Residence Demographics 86

Table 6. Gender, Age, Education, Ancestry, Occupation, & Monthly Income Demographics 87

Table 7. Participant Observation Types & Objectives 90

Table 8. Cross Tab Analysis of Years of Residence with Household Water & Energy Conservation 104

Table 9. Cross Tab Analysis of East End Years of Residence with Whether There Have Been Electricity Supplier Issues 106

Table 10. Cross Tab Analysis of Education with Perceptions of Renewable Energy Projects 107

Table 11. Cross Tab Analysis of East End Education with Perceptions of Renewable Energy Projects 108

Table 12. Cross Tab Analysis of Occupation with Perceptions of Water Supplier Quality 109

Table 13. Cross Tab Analysis of East End Occupation with Concerns About Water Supplier Quality 111

Table 14. Cross Tab Analysis of Northside Occupation with Perceptions of Water Supplier Quality 112

Table 15. Cross Tab Analysis of Years of Residence with Perceptions of Wastewater Danger 113

Table 16. Cross Tab Analysis of Gender, Education & Occupation with Perceptions of Coastal Environment Health 121

Table 17. Cross Tab Analysis of East End Gender with Perceptions of Coastal Environment Health 123

Table 18. Cross Tab Analysis of Northside Occupation with Perceptions of Coastal Environment Health 124

Table 19. Cross Tab Analysis of Northside Occupation with Perceptions Climate Change 125

Table 20. Cross Tab Analysis of Northside Occupation Perceptions of Climate Change and Disaster Impacts on St. Thomas 126

Table 21. Cross Tab Analysis of Age with Perceptions of Community Disaster Recovery 127

Table 22. Cross Tab Analysis of East End Years of Residence with Perceptions of Community Disaster Recovery 129

Table 23. Cross Tab Analysis of East End Years of Residence with Familiarity with What to do in a Disaster 130

Table 24. Opinions About Who Should Be in Charge of Disaster Planning 131

Table 25. Opinions About Who Should Be in Charge of Combating Climate Change 134

Table 26. Opinions About Who Should Be in Charge of Protecting the Coastal Environment from Sewage 136

Table 27. LK Word Cloud Word Count 138

Table 28. AK Word Cloud Word Count 140

LIST OF FIGURES

Figure 1. St. Thomas Bridge to Nowhere in August 2016 2

Figure 2. Google Earth Image of BtN and Turpentine Run 3

Figure 3. St. Thomas BtN during Irma & Maria 4

Figure 4. Map of the United States Virgin Islands 8

Figure 5. Venn Diagram of Political Ecology Intersections 16

Figure 6. The Circle of Capacity from Wisner, Gaillard and Kelman 2012 40

Figure 7. Water Delivery Truck 69

Figure 8. Participatory Map Made with Focus Group 77

Figure 9. Moravian Church Members Attending Public Memorial Day Event 84

Figure 10. Map Showing Survey Data Collection Locations on St. Thomas 85

Figure 11. Photo of Saturday Market Charlotte Amalie 91

Figure 12. Photo of Tillett Gardens Hostel & Shops in Tutu Area (East End) 92

Figure 13. Photo of St. Thomas East End Moravian Church 93

Figure 14. Graph of Household Water & Energy Conservation by Years of Residence 104

Figure 15. Graph of East End Perceptions of Electricity Supplier Quality by Years of Residence 106

Figure 16. Graph of Perceptions of Renewable Energy Projects by Education 107

Figure 17. Graph of East End Perceptions of Renewable Energy Projects by Education 108

Figure 18. Graph of Perceptions of Water Supplier Quality by Occupation 110

Figure 19. Graph of East End Concerns with Water Supplier Quality by Occupation 111

Figure 20. Graph of Northside Perceptions of Water Supplier Quality by Occupation 112

Figure 21. Graph of Perceptions of Wastewater Danger by Years of Residence 113

Figure 22. CARICOM CCORAL Steps in Risk Management Process 115

Figure 23. FEMA Threat and Hazard Identification and Risk Assessment 116

Figure 24. EPA CREAT Process..... 117

Figure 25. Graph of Perceptions of Coastal Environment Health by Gender..... 121

Figure 26. Graph of Perceptions of Coastal Environment Health by Occupation 122

Figure 27. Graph of Perceptions of Coastal Environment Health by Education 122

Figure 28. Graph of East End Perceptions of Coastal Environmental Health by Gender..... 123

Figure 29. Graph of Northside Perceptions of Coastal Environment Health by Occupation 124

Figure 30. Graph of Northside Perceptions of Climate Change by Occupation 125

Figure 31. Graph of Northside Perceptions of Climate Change Impacts on St. Thomas by Occupation 126

Figure 32. Graph of Perceptions of Community Disaster Recovery by Age 128

Figure 33. Graph of East End Perceptions of Community Disaster Recovery by Years of Residence 129

Figure 34. Graph of East End Familiarity with What to do in a Disaster by Years of Residence 130

Figure 35. Graph of All Responses to Who Should Be in Charge of Disaster Planning? 132

Figure 36. Graph of East End Responses to Who Should Be in Charge of Disaster Planning?..... 132

Figure 37. Graph of Northside Responses to Who Should Be in Charge of Disaster Planning?..... 132

Figure 38. Graph of All Responses to Who Should Be in Charge of Combating Climate Change?..... 134

Figure 39. Graph of East End Responses to Who Should Be In Charge of Combating Climate Change?..... 134

Figure 40. Graph of Northside Responses to Who Should Be in Charge of Combating Climate Change? 135

Figure 41. Graph of All Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment? 136

Figure 42. Graph of East End Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment? 136

Figure 43. Graph of Northside Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment? 137

Figure 44. LK Word cloud 138

Figure 45. AK Word Cloud 139

Figure 46. USVI Circle of Capacity Model adapted from Wisner et al. (2012) 165

Figure 47. Donoe Solar Array After Irma & Maria 2017 169

Figure 48. Building Back Better Assessment Model 170

ABSTRACT

Increasingly communities are impacted by slow-onset and sudden hazards. With reports of disasters affecting millions of people and with severe impacts on lives and livelihoods, there is a focus on creating cities that make human settlement inclusive, safe, resilient and sustainable. Within this focus are the mandates that safe drinking water, energy and wastewater sanitation are the right of all people living on the planet. This research addresses water and energy insecurity, highlights the gaps in community level perceptions of water and energy, and global-local dynamics that impact disaster vulnerability through a political-ecology lens.

This work examines how disaster resilience and vulnerability factor into sustainable development and coastal resource use at multiple scales, local and global. As part of this multi-scale, political ecology approach I investigate differing knowledge scales, authoritative and local, that influence the sustainable wastewater development and disaster mitigation policies on St. Thomas in the U.S. Virgin Islands. Of concern is who contributes to the policy process and who is not being considered, and how it influences local perceptions regarding (waste) water, energy and disaster development.

My research goal is to investigate the perceptions of AK and LK holders, to elicit information that interprets the political ecology of the water-energy nexus. Within this goal are two areas: one involving local knowledge regarding the water-energy nexus and disaster, and the other concerned with authoritative knowledge and collaborative resource management. This research employed ethnographic methods that rely on a survey instrument to elicit information about environmental, water, energy and disaster risk perceptions. Semi-structured interviews,

participant observation, and a mapping exercise were used to learn the participant's conceptions of their local environment, water, energy, wastewater, and disaster vulnerability.

The concept of Building Back Better (BBB) is a phrase seen often in news reports and policy recommendations (UNISDR 2017) in the post-disaster environment. It usually refers to the period after a disaster in which there is reflection on how to reduce disaster vulnerability and fortify against the next catastrophic event. The sense is that a community can make changes during the rebuilding period that will enable it to withstand the destructive impacts of future disasters. Wisner (2017) and others (Di Giovanni 2017; Khasalamwa 2009) offer a critical perspective of adopting a BBB approach to disaster recovery and vulnerability, and argue that a broader perspective is required that recognizes the complexities of pre-disaster societies.

Results reveal that the post-disaster BBB phase presents an opportunity to critically evaluate (waste) water, energy, and disaster reduction policies and practices for potential failures. Divergent knowledges based on cultural models that keep segments of a community apart needs a platform for integration. In the long history of anthropological scholarship, bridging gaps has been a common theme. As cultural translators, we take as our responsibility being cultural brokers whose job it is to make the strange less so, facilitating collaboration and participation. The question is how to create the opportunity for alliance. I suggest that St. Thomas is the ideal place to explore what can be possible if (waste) water and energy policy development, and sustainable disaster planning, embraces multivocality. The outcome could be building a community that has a stronger capacity to recovery from disaster before the next storm.

CHAPTER ONE: INTRODUCTION

Setting: The Bridge to Nowhere

It was during a van ride from the University of the Virgin Islands to an eco-tour business, one that offers kayak and snorkeling tours in the east end Mangrove Lagoon on St. Thomas, that I first heard reference to someplace called the “bridge to nowhere”. The kayaking tour was a field trip coordinated by the Established Program to Stimulate Competitive Research (EPSCoR) conference organizers within the University of the Virgin Islands (UVI). The tour was offered as a way to help participants see first-hand some of the research sites that both professors and graduate students in the Marine and Environmental Sciences department of UVI were involved in. Around ten of us packed into the department van and headed from the west end of St. Thomas to the east end to see the Mangrove Lagoon located next to the Bovoni landfill and a horse racing track. As scientists and educators, we were excited to have the opportunity to have a guided tour of the lagoon and learn about the impacts of seepage from the overcapacity landfill and the pollutants flowing down through the watershed.

My fellow passengers consisted of researchers, visiting primary school teachers from St. Croix whose students take part in water cycle projects with an EPSCoR project, and graduate students. Squished on the van seat between the department’s only marine biology post-doctoral student originally from Colombia, and one of the visiting primary school teachers. I was listening to a conversation amongst the passengers when I overhead the van driver talking about how to get to the eco-tour location. She said we would be making a turn at the “bridge to nowhere”. The other van passengers began to talk about this phenomenon and said it was a section of bridge

with no connection to any roads (Figure 1). My initial reaction was amusement at an incomplete public works project causing such strong opinions, mostly disdain with the government for wasting public funds. As my time on St. Thomas progressed, I learned that the Bridge to Nowhere was a symbol not just of an unfinished disaster mitigation project, but that it was also a metaphor for the larger perceptions and connections that island residents have with both the local and the federal United States governments.

Figure 1. St. Thomas Bridge to Nowhere in August 2016

The Territorial Government's Bridge Project

The "Bridge to Nowhere" ("BtN") project is an example of how disaster mitigation plays out in the Virgin Islands, and it highlights the interplay between infrastructure projects, water and disaster mitigation. The BtN project started in 1997 as a flood mitigation project after Hurricane Marilyn struck St. Thomas in 1995. The flooding that resulted from Marilyn impacted some neighborhoods more than others, such as the Bovoni and Nadir areas. These areas are next to each other in the low-lying coastal region of the southeastern portion of the island. Turpentine Run (also known as Turpentine Gut) (Figure 2) has long been the only water conduit moving the heavy rains from the surrounding watershed out to the mangrove lagoon bordering the coast. In the past, and during hurricanes Irma and Maria in 2017, it has often failed to effectively reduce

flooding in the surrounding neighborhoods causing many residents to cope with frequent flooding of their homes and neighborhoods. The $9.6 million project (VIBER 2019:8) was developed to replace the existing bridge and gut with a new higher bridge and a wider gut, but due to land acquisition issues arising early on, the project stalled at the point of the new bridge upper deck being built, but none of the connecting roads or gut expansion being completed for the next 20 years (Virgin Islands Consortium 2017).

An article in the local newspaper highlights the challenges and frustration that the BtN project caused in the community, as the author notes "The Turpentine Run construction project on St. Thomas stands as a prime example of poor construction management in the U.S Territory. After 21 years, the joint efforts of the V.I. government and the U.S. Department of Transportation have failed to complete the project" (MacVean 2019). The project picked up speed in 2016 when the local government announced that it was renewing efforts to complete the bridge and incorporate it into a larger project to improve traffic flow at the intersection the bridge connects with, but at the time of hurricanes Irma and Maria the project had not been completed and residents experienced historic flooding (Figure 3) in the Nadir neighborhood (George 2017).

Figure 2. Google Earth Image of BtN and Turpentine Run Before Renewed Efforts at Construction – highlighted by yellow arrows (accessed September 29, 2019)

Figure 3. St. Thomas BtN during Irma & Maria (George 2018)

The BtN project is an example of the difficulties that infrastructure projects in the US Virgin Islands have to contend with, a factor I explore in more detail in Chapter Six, the discussion chapter.

The Mangrove Lagoon eco-tour was early on in my field research but the BtN continued to be a prominent feature in resident's opinions about the local government. When asked about whether they thought St. Thomas could recover from a major disaster event, people often pointed to the BtN as an example of corrupt government practices that left the community vulnerable in the post-disaster environment. The BtN came to be a metaphor for the disconnect between the community and various political levels. This metaphor also became important to my field research and influenced my understanding of the global-local dynamics impacting disaster vulnerability and local infrastructures on St. Thomas.

Purpose for the Research

My dissertation research informs components of the USF National Science Foundation Partnership for International Research and Education (PIRE) project that focused on the water-energy nexus and local wastewater perceptions. In addition, this project examines how disaster

resilience and vulnerability factor into sustainable development and coastal resource use at multiple scales, local and global, and applies a political ecology framework. As part of this multi-scale, political ecology approach I investigate differing knowledge scales, authoritative and local, that influence the sustainable (waste) water and energy development, and disaster mitigation policies in the U.S. Virgin Islands. Of concern is who contributes to the policy process and who is not being considered, and how it influences local perceptions regarding (waste) water, energy, and disaster development. This research is exploratory and preliminary, and can provide a basis for future research.

Increasingly communities are impacted by slow-onset and sudden hazards. Globally, in 2018 there were 315 reported disasters with 68.5 million people affected, resulting in an economic impact of 132 billion (USD) (CRED 2018). The United Nations Sustainable Development Goals (UN-SDGs) goal 11stipulates that cities make human settlement inclusive, safe, resilient and sustainable. Sustainable Development Goal #11 notes that there has been a statistical increase in the number of households impacted by disasters due to hazards from 1990 to 2013, from 98,000 to 1,890,000 (UN-SDGs 2018). The UN-SDGs report (2018) also states that there has been an increase in deaths from small to medium scale disasters, with low-income families and small businesses affected more frequently (https://unstats.un.org/sdgs/report/2018/overview/; accessed September 11, 2019). Impacts are due to "exposure to hazards, vulnerable conditions and lower coping capacity" (UN-SDGs 2018). The report recommends that focus should be placed on promoting public and private investments that reduce disaster risk, that include investments in infrastructure in flood-prone regions, and include urban land use planning that is informed by risks (UN-SDGs 2018).

Likewise, the combined UN and World health Organization initiative focused on ensuring sustainable development of water and sanitation (WHO 2014), mandates that safe drinking water and wastewater sanitation are the right of all people living on the planet. Anthropologist, Maryann Cairns (2014) notes in her dissertation that there is a great deal of research related to water in general, but wastewater within the social sciences has received less attention (some notable exceptions include the work of the USF NSF PIRE work from 2014 to 2018, Alley 2006, 2012 and Ratner et al. 2004). The following dissertation addresses the gaps highlighted above and seeks to advance the recommendations of the UN-SDGs related to water, wastewater, and disaster vulnerability. The SDGs call for emphasizing sustainable development of water is critical for the eradication of poverty and hunger. Since water, energy, food security and nutrition are linked and water is indispensable for human development, health and well being. Water is a vital element that needs to be considered when achieving the UN-SDGs (UN-SDG Resolution 2016: 2).

Furthermore, international bodies advocate for communities to have access to a safe drinking water source, basic sanitation and sound hygiene, and recommend that policy development address water-related disasters, water scarcity and water pollution. These measures assist communities in building capacity to ensure water resiliency. The UN-SDGs 2016 resolution is concerned that threats to water related ecosystems by poor management and unsustainable development are exacerbated by climate change and other factors, and that communities need to develop and implement holistic disaster risk management at all levels.

Contributions to Anthropology & Disaster Research

There is a general lack of social science, and specifically anthropological, research concerning the U.S. Virgin Islands. Authors like Michel-Rolph Trouillot (1992) have suggested

in the past that Caribbean anthropology says more about anthropology than about a particular region "where boundaries are notoriously fuzzy...neither center nor periphery, but a sort of no man's land where pioneers get lost, where some stop overnight on their way to greater opportunities, and where yet others manage to create their own 'new' world amidst First-World indifference" (Trouillot 1992:19). Recognizing this, the anthropological endeavor attempts to draw connections, like Sidney Mintz (1996) says, between the Caribbean region and global dynamics, while also interrogating how the global is constituted locally. Moreover, Cynthia Grace-McCaskey and others (Mintz 1996; Yelvington 1996) argue for more grounded ethnographic research in the region (2012:91) that explores the U.S. Virgin Islands within the larger Caribbean and global context (Figure 4 is a map showing the USVI in relation to the broader Caribbean region), but also paying attention to its uniqueness of location and historic, economic, and environmental influences. Much like López-Marrero and Wisner (2012) who argue that local context matters to understanding disaster vulnerability, I situate the following work in the local island context of St. Thomas, to explore how that context produces a particular approach to (waste) water, energy and disaster vulnerability. This allows for exploration of island specific domains of authoritative knowledge (AK) and local knowledge (LK), and how AK and LK influence disaster resilience and recovery capacities. Building on the work done by B. R. Johnston (1987, 1994), my anthropological exploration of (waste) water, energy, and disaster vulnerability, AK and LK, incorporates an exploration of the political ecology of coastal resources and utility infrastructures on St. Thomas, USVI.

The traits the U.S. Virgin Islands share with the rest of the Caribbean region include a long pre- and post-colonial history that involves periods of pre-colonial Indigenous peoples inhabiting the islands, colonial European economic and religious expansion, and post-colonial

ethnic relationships. Although the current St. Thomas context is the result of its own historical trajectory and current political dynamics, as suggested by López-Marrero and Wisner (2012), exploration of each island nation should account for how they are internally different in conjunction with the broader global forces shaping each one.

Figure 4. Map of the United States Virgin Islands (Magellan Geographix 1997)

Research Objectives, Questions and Hypothesis

My research goal is to investigate the perceptions of AK and LK holders, to elicit information that interprets the political ecology of the water-energy nexus. Within this goal are two areas: one involving local knowledge regarding the water-energy nexus and disaster, and the other concerned with authoritative knowledge and collaborative resource management.

Overarching Research Topic

The focus of this research is to document how human perceptions and practices, in conjunction with federal policies in the US Virgin Island of St. Thomas, shape wastewater

management and how those policies impact coastal health and livelihoods, with particular attention to reduce disaster vulnerability and enhance resilience.

Research Objectives, Questions & Hypotheses

1. To conduct an exploratory study of the risk of a water/energy disaster and mechanisms to reduce vulnerability and enhance resilience;
2. To identify local, national, and global factors that contribute to increased disaster risk;
3. To apply a political ecology framework to construct models to enhance community resilience in the face of identified potential water/energy disasters;
4. To provide evidence to inform policy making and future research.

The above objectives are addressed by investigating the following research questions and hypotheses:

1. What is the current structure of (waste) water and energy utilities, coastal resource management, and disaster planning on St. Thomas, USVI, and how can the policies related to infrastructures work for the local context, given global-local dynamics influencing the policy process?

   Hypothesis 1 (H1): Because the USVI exists at a cross-point between U.S. federal policies and regulations and the broader Caribbean context, current structures follow closely the U.S. Federal programs for addressing (waste) water and energy utilities, coastal resource management, and disaster planning. The federal programs operate with limited inclusion of the uniquely local Caribbean challenges, such as access to funding and expertise needed to implement federal regulations.
2. How do the local USVI government agencies understand “risk” and “vulnerability”, and how is their understanding similar/different to how other institutions and social sciences

assess them? How does that translate into policies concerning water, energy, and disaster infrastructures?

Hypothesis 2 (H2): Risk and vulnerability are viewed as tied to geophysical and environmental hazards, and less as complex political ecological events. Infrastructures are viewed as independent, technological and scientific, and are seen as disconnected from historical, political, and social processes, resulting in a less resilient community.

3. What is the relationship between authoritative knowledge and local knowledge in disaster mitigation planning and coastal resource management on St. Thomas, USVI?

   Hypothesis 3 (H3): There remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management. These challenges are described in the EPA OIG Audit report (2015) which highlights the environmental issues and wastewater in the USVI. The disconnect is described further in the VITEMA Territorial Hazard Mitigation Plan (2014), which notes the vulnerability of utility infrastructures in the U.S. Virgin Islands. These circumstances then impact policy decision-making related to water and energy utilities, coastal resource management, and disaster risk reduction, potentially creating points of vulnerability.

This research is an ethnographic exploration that offers a preliminary and exploratory investigation of the intersection between disaster mitigation and sustainable development through the lens of political ecology. Intersection refers to the point that (waste) water, energy, political ecology, and disaster meet to produce local and extra local perceptions and vulnerabilities. I relied on; participant observation, a survey instrument that elicited information about environmental/water/energy/disaster risk perceptions, semi-structured interviews, participant observation, and focus group exercises designed to learn the participant's conceptions

of their local environment. Utilizing these methods permitted me to answer the three research questions and contribute to the ongoing anthropological discussion concerned with how to build (waste) water and energy sustainability and develop disaster resilient communities.

Dissertation Outline

Chapter Two contains a review of the academic literature and is sectioned into four segments that establish the theoretical foundations for the research. It begins with an introduction to the political ecology framework that is the basis for how I explore disaster, wastewater, water, energy, and the environment. Political ecology as a theoretical framework draws attention to the power dynamics influencing access to resources and the environment. It emphasises the critical exploration of the interconnections among development, water, energy, wastewater and disaster. This approach traces the disconnects between local community members and the broader processes that impact their (waste) water, energy and disaster vulnerabilities. The next section covers a summary of the literature concerned with disasters and anthropology and assessing vulnerability. This subsection outlines how I understand vulnerability and apply the concept in this research through the Pressure and Release Model (PaR). The PaR model expands on our understanding and investigates pre- and post-disaster risk and vulnerability. The final sections of Chapter Two focus on the anthropological work related to infrastructures, and the concept of Building Back Better (BBB), a relatively new area of study within disaster anthropology that requires more attention. The anthropological critique of BBB allows for interrogation of how the response to disasters perpetuate or give space to divergent approaches to building resilience in a community.

Chapter Three establishes the research setting by describing the St. Thomas characteristics. It highlights the importance of conducting disaster vulnerability and

infrastructures research in the Caribbean. This chapter outlines the political ecology of (waste) water, energy and disaster from the unique perspective of a U.S. territory in the Caribbean. As part of establishing the local St. Thomas research setting, I briefly describe the historical periods that impacted the region, including the pre-colonial, colonial, and post-colonial (or neo-colonial) periods. The next sections in Chapter Three present the historical disasters that have impacted the United States Virgin Islands and FEMA's policies. It concludes with a discussion of the historical trajectory of water, wastewater and energy development on St. Thomas, that includes a description of their challenges.

Chapter Four outlines the research methodology employed with sections dedicated to describing the semi-structured interviews, focus group, participatory mapping, surveys, and research design. This chapter includes a description of the analytical approach adopted to explore the data, and concludes with a description of the ethical approach and the limitations I encountered while conducting the field research.

Chapter Five presents the results from the analysis of the data and is sectioned by each hypothesis. The results are based on the qualitative data analysis conducted on the survey results and interview coding. This chapter includes tables and figures developed from the chi-square analysis and crosstabulation analysis. Word Cloud figures categorized by AK and LK are used to show the word frequencies drawn from the interviews. The Results Chapter establishes the basis for the discussion of (waste) water, energy and disaster in the next chapter.

Chapter Six is the discussion portion of the dissertation that explores the results from the quantitative data analysis in the preceding chapter. It ties the quantitative data to the qualitative data drawn from the interview responses, participant observation descriptions and existing literature. I arrange this chapter with each of the hypothesis's sections defined in Chapter Five,

and work through a discussion to draw conclusions concerning water, energy, wastewater, and disaster vulnerability in the U.S. Virgin Islands. It concludes with a synthesis of the data and literature in a discussion of the Building Back Better post-disaster period on St. Thomas.

Chapter Seven is the concluding chapter that reflects on what was learned and makes recommendations for actionable items that communities can utilize. This chapter is arranged by the three research questions presented above and draws broader connections among the water-energy nexus and disaster vulnerability in a Caribbean context. The findings are embedded in the larger anthropological literature presented in Chapter 2, and supports the literature that identifies disaster pressures, (waste) water and energy challenges, and multivocality as a factor when developing community capacity. Finally, I provide a list of recommendations directed at the Virgin Islands Territory Emergency Management Agency, local government energy, water and wastewater agencies. The goal is to make recommendations that support disaster capacity building and sustainable development solutions for USVI residents. For practical purposes, and to increase the applicability and tangibility of this research, I focus on the local scale versus directing policy recommendations to the federal level. This study highlights that there are immediate needs in the USVI that require concrete solutions to disaster vulnerability and local infrastructures that can potentially be addressed by local agencies, organizations, and residents.

Chapter Summary

This chapter begins by introducing the field research site and situates the research in the St. Thomas setting through a description of a local BtN disaster mitigation project. It then draws connections between this study and the international recommendations made by the United Nations and World Health Organization for safe and secure communities to have reliable access to the resources, such as water, as a human right. I then highlight the contribution this research

makes to the discipline of anthropology, specifically focused on political ecology, disaster and the water-energy nexus. This section is followed by an outline of my research objectives and questions, as the guide for the work contained in this dissertation. Finally, I provide a brief description of each of the six chapters contained in this work and conclude with my recommendations for application.

CHAPTER TWO: LITERATURE REVIEW

Chapter Overview

This dissertation research is concerned with the human-environment relationship as it relates to wastewater, water, energy, and disaster vulnerability. This work seeks to move beyond seeing community structure and infrastructure vulnerability as purely the result of physical weaknesses that result in collapse due to disasters. The research goal is to address vulnerability at the social, environmental, and infrastructure scales. Therefore, in this chapter I provide a survey of the existing literature related to political ecology, water, wastewater, energy, local and authoritative knowledge, disaster risk and vulnerability, and infrastructures. My focus is on how each of these aspects are theorized and how they are relevant to the St. Thomas, USVI context. The first section begins by discussing the emergence of a political ecology framework in anthropology and its evolution resulting in the current approach to understanding the human-environment relationship. I then apply the political ecology framework to water, wastewater, and energy, highlighting the complexity of the human-water and energy nexus. The goal is to fill the identified gaps in our knowledge about how vulnerability is perceived and mitigated on a small Caribbean island. With special attention to multiple scales and global-local dynamics. Therefore, I present the literature concerned with disaster anthropology, local and authoritative knowledge, vulnerability and risk perceptions/assessments that highlight the overall connections between community disaster vulnerability and the water-energy nexus.

Political Ecology

Political Ecology and Anthropology

Political ecology theorizes that humans are not separate from nature, but that they are both shaped by and shape the biophysical environment around them. Within this framework is the argument that the human-environment relationship is influenced by political and economic forces at both the local and the global level. At its foundation, political ecology draws on political economy and cultural ecology, and both the physical and social sciences (Biersack et al. 2012; Gezon and Paulson 2005). Drawing on all these fields, political ecology as a framework, broadens an investigation into the water-energy nexus and disaster vulnerability by showing the intersections between economics, the environment, politics and broader culture systems (Figure 5).

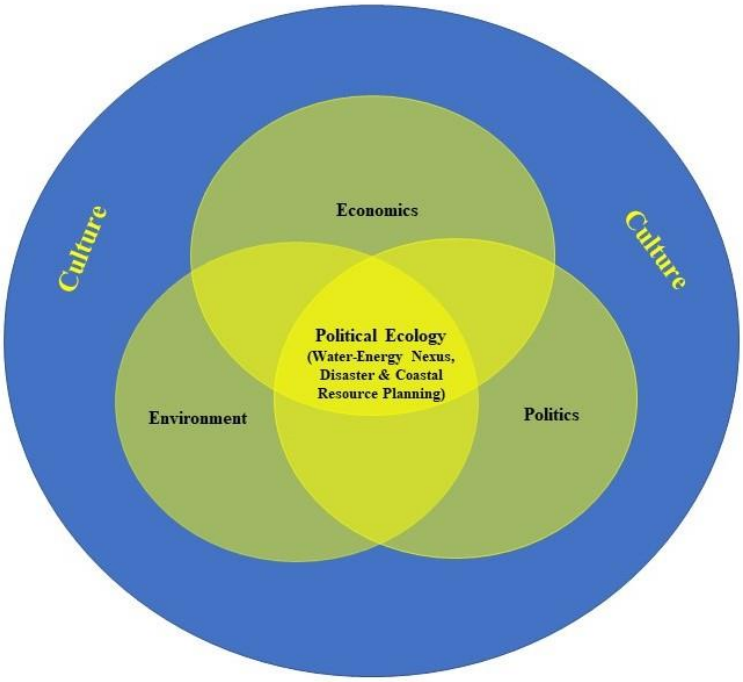

Figure 5. Venn Diagram of Political Ecology Intersections

During the post-modernist period anthropologists critiqued the assumptions within political ecology that the human-environmental relationship is ahistorical and apolitical, and that

prior to that point it failed to consider the long historical depth leading to differential power and authority throughout the world. Early ecology approaches "presumed, without demonstrating, equilibrium, self-regulation, or homeostasis; [and] it overlooked social actors and their choices; that it 'vulgarly' ignored the social relations of production, which organized human-nature articulations, that it reduced culture to nature; that it was ahistorical and localistic, ignoring global factors" (Biersack 2012:8). Today, scholars address these shortcomings by recognizing that political ecology has a tendency towards dis-equilibrium, that various actors and their choices impact the human-environment relationship, and that a more comprehensive understanding involves multiple scales.

Furthermore, political ecology takes as its subject the social/environmental changes and the conditions they occur through, with an understanding that power influences the process. It is interested in locating causes "rather than symptoms of problems, including starvation, soil erosion, landlessness, biodiversity decline, human health crises, [but is interested in] the more general and pernicious conditions where some social actors exploit other people and environments for limited gain at collective cost" (Robbins 2004:20). The focus is on finding a more equitable, sustainable, and less exploitative solution to environmental problems, realizing that ecological systems are political and how we think about them is impacted by political and economic processes. Robbins (2004) refers to this as the "Jekyll and Hyde" approach. Political ecology is attempting two things, critiquing the dominant accounts of environmental change, and exploring how human actions provide alternatives and adaptations to exploitation. From this, we understand that impacts flow among multiple scales at the global and local levels.

Several authors have contributed to the concept of scale within political ecology (Biersack et al. 2012; Gezon and Paulson 2005, Wells et al. 2014a, Wells et al. 2014b; Whiteford

and Whiteford 2005). Scale refers to the political level and position a community has in the world context, such as international and the local community. Community scale is not a set geographical construct, but shifts among different stakeholders with regard to perceptions and practices, and is shaped by "institutional arrangements" that are "subject to structural inequities in access to resources" (Wells et al. 2014b:2). Applying this idea of scale to understanding development reveals the power dynamics shaping the local context.

Building on the notion of scale, recent work in political ecology suggests a more dynamic and interrelated relationship between humans and the environment. Political ecology scholars refer to the human-environment relationship as "second nature" (Biersack 2006) or "after nature" (Escobar 1999). It is the nature that emerges through human activity and discourse, establishing the complex relationship humans have with the environment. Humans construct nature and create its meaning, so what is perceived as "natural" is also cultural (Escobar 1999). Taking a constructivist political ecology perspective permits further investigation into who's reality of nature is being constructed and for what purpose (Biersack 2006)? How is a second nature being constructed and who controls the discourse (Gezon and Paulson 2005)? In the case of wastewater, energy, and disaster management on St. Thomas, these questions are relevant to understanding the global and local perspectives and policies shaping watershed management and utility infrastructure vulnerability.

Likewise, emerging trends in anthropology and political ecology has seen a shift of the research focus to the developed parts of the world (Breslow 2014, Grace-McCaskey 2012; Schroeder 2006). The scholars who have shifted the political ecology focus from the Third World to the First (Schroeder et al. use the First World/Third World descriptors here, which should be problematized as it implies superiority, but as the authors note, the work they describe

breaks down these distinctions) have maintained a similar approach, suggesting an emerging set of common themes that can be applied to more developed communities as well (Schroeder et al. 2006). These core themes noted by Schroeder et al. include "community-based resource management, the question of competing scientific and lay knowledge systems, strict protection versus consumptive use of wildlife, ecotourism as development planning panacea, intersecting processes of social and environmental marginalization" (2006:165), and others, are familiar to those doing work in Third World contexts. As well, this repositioning of political ecology suggests a rejection of the First World/Third World binary. This approach recognizes First World heterogeneity and diversity that is not based solely on capitalist frameworks. Resource use does not simply exist in the Third World or First World site, but can be seen to exist along a continuum, allowing for expanded understanding of how best to manage resources in both contexts. What works and does not work in one community can inform practices in another (Grace-McCaskey 2012; Schroeder et al. 2006). Applying a flexible understanding to the applicability of political ecology from different parts of the world means that political ecology can be a useful framework for investigating the intersection of wastewater, energy, and utility vulnerabilities in the U.S. Virgin Islands as a location situated in between the broader United States and the rest of the Caribbean region.

When considering the global-local dynamics in the U.S. Virgin Islands, I orient my understanding through the concept of globalization. Anna Tsing (2005) describes globalization as "friction". She notes "Cultures are continually co-produced in the interactions I call 'friction': the awkward, unequal, unstable, and creative qualities of interconnection across difference" (Tsing 2005:4). This approach to understanding global processes involves interrogating the dynamic and diverse cultural interactions that produce the local lived experience, and accounts

for the messiness of trying to incorporate the global into ethnographic understanding of local processes from a political ecology perspective. Tied closely to how we understand political ecology is how development takes place in local contexts.

Political Ecology and Development

Development studies relate to political ecology and water through what Escobar refers to as the discourse of development. As a form of "colonization of reality" (2012:5), the post-World War II conception of development was shaped by prevailing ideology in the 1950s that embraced the idea that less developed parts of the world should seek to achieve the same level of "modernity" as the global "West". Like political ecology, development studies are concerned with power or dominance as Escobar refers to it (2012). Development discourse is tied closely to the human-environment relationship through the issue of power.

Early development discourse embraced development as the way to industrialization and urbanization, through agricultural technology, rapid growth of material production, and adoption of modern education and cultural values. Put otherwise, development was reliant on advancing ideas related to capital, science and technology (Escobar 2012:4). It was in the rest of the world's best interest to support such development in places like the "Third World" to ensure global economic security. This notion of modernization created the foundation for contemporary approaches to development.

Escobar (2012) offers a critical reflection on how development projects perpetuate colonization through a modernizing approach and the discourse that accompanies development, an approach that:

> has created an extremely efficient apparatus for producing knowledge about, and the exercise of power over, the Third World. This apparatus came into existence roughly in the period 1945 to 1955 and has not since ceased to produce new arrangements of knowledge and power, new practices, theories, strategies, and so on. In sum, it has successfully deployed a regime of government over the Third World, a "'space for 'subject peoples'" that ensures certain control over it (Escobar 2012:9)

Furthermore, Escobar (2012) states development discourse emerged through framing the "Third World" as in "need" of modernization or as "underdeveloped". Failing to critically reflect on the global historical, political and economic forces creating the local context fails to account for local agency and ways of knowing. Said (1978) calls this process "Orientalism" when discussing how the West conceptualizes the East. It served the colonizer's best interest to create a notion of a naive and helpless Orient, which persists in some ways today. Conversely, this interpretation of development discourse, although very relevant, does not account for local expression of agency in response to development initiatives, and it should be noted that much scholarship is devoted to understanding how agency is expressed in the local context among villagers and Indigenous peoples, for example (Brosius 2006). The complexity of understanding development in a local setting is compounded by the various actors and how they conceive of the development process. Much of the argument over who is influencing the development process led to greater contemplation of the effectiveness of development paradigm itself.

The post-modernist turn resulted in a realization that the push for global modernization through development was unsuccessful. Many parts of the world were continuing to be degraded socially and environmentally. Sustainable development emerged as a new discourse, one that

sought and continues to seek equality for marginalized peoples and environmental protections through economic development (Sillitoe 2014). From this perspective, development is viewed through a critical lens, with questions arising as to whether it is truly sustainable, both environmentally and socially. Within the political ecology framework, we should continue to ask "what makes development sustainable?" Is it possible that sustainable development projects are more focused on technological solutions and do not consider the local and global power dynamics that impact who benefits from them (Wells et al. 2014b)? These questions have influenced my research design concerned with how development has been, and continues to be, undertaken in the USVI.

Political Ecology of Water and Energy

Literature shows that water and wastewater are culturally constructed concepts, and that they are differentially conceived depending on the population or community (Whiteford 1997; Wells and Davis-Salazar 2008; Zarger 1998, 2009; Whiteford et al. 2014, 2015). Water has been conceptualized by some as part of a hydrosocial cycle that seeks to interpret the human-water relationship as a combination of a physical and social processes. This is counter to how water has been projected within the technological and scientific realm, which sees water as an element within the hydrologic cycle to be managed (H_2O) through infrastructures and scientific expertise (Linton and Budds 2014). Linton and Budds developed a framework for understanding the hydrosocial through a critical political ecology of water, and argue that "water internalizes social relations and politics, as opposed to being merely the object of politics" (2014:171), suggesting complexity regarding how humans perceive and respond to water, and vice versa. The hydrosocial concept incorporates an understanding of how the hydrologic cycle arose to a representation of water that is based on a particular historical context and emerged through a

specific political process. Authors, Bear and Bull (2011) recommend a movement away from anthropocentric approaches to studying water based on terrestrocentrism and call for a recognition of the multiple materialities of water, not only as rivers and oceans, but also water in its many other forms. The hydrosocial framework provides a robust means to critically investigate water development, but has limitations when considering energy in the water cycle. This framework has not been used consistently to critically assess energy development as part of the hydrosocial processes.

Literature concerning the hydrosocial cycle and energy has included a focus on the desalination process and tourist development in southern Spain (Baños et al. 2019) and the intersection of a gas pipeline, desalination of sea water and recycling of wastewater in the United Arab Emirates (McDonnell 2013). These authors interrogate the assumptions that water and energy processes emerge independently and devoid of social outcomes and consequences. McDonnell notes:

> More specifically, the case of Abu Dhabi highlights the role of energy in the hydrosocial cycle. The water-energy nexus is increasingly recognised in scholarship and policy yet is treated in predominantly technical and scientific terms. The role of energy in driving Abu Dhabi's hydrosocial cycle is absolutely paramount. Relying on energy to fuel water production and distribution extends the hydrosocial cycle far beyond the catchment (or, more precisely in the context of Abu Dhabi, the groundwater discharge zone), with implications that have been largely overlooked to date. (2013:232)

Furthermore, Baños et al. identify the links among increased tourism, consumption of water and the development of desalination systems in Alicante, Spain. These authors found that in this semi-arid region, access to water was not a limiting factor, but has resulted in an "intense spatial transformation [that] involved the consumption of considerable natural resources" (Baños et al.

2019:16). These authors highlight the importance of integrating greater investigation of the role of energy in the hydrosocial cycle.

Extending this critical examination of the hydrosocial framework, water research includes authors who argue that a political ecology of water should include wastewater as part of the larger water and energy system (Whiteford et al. 2015), and investigate the intersection of power and global-local processes that produce wastewater systems around the world. Alley's (2006, 2012) anthropological research focused on wastewater management in northern India, looked at a point when projects were focused on improving urban sanitation and drinking water quality. This work explored the wastewater infrastructure decision-making process and the broader cultural model embracing the religious importance of the river Ganga. Similarly, Ratner's and Rivera Guitiérrez's (2004) work in Panajachel, Guatemala showed that displaced social networks that previously managed the waterworks prior to state and market management can produce an opportunity to re-embed the community in water management strategies, but in a new way. Instead of being tied to the traditional Mayan civic-religious governance approach, new approaches to community inclusion in wastewater management are based on business networks that rely on the tourist industry (Ratner and Rivera Guitiérrez 2004).

Integrated Water Resource Management

Recent work on the hydrosocial and water systems has begun looking into the integrative approach to water management. Integrated Water Resource Management (IWRM) has become a common approach to water management in project planning. Emerging in the 1990s, IWRM is based on an ecosystem perspective (Johnston et al. 2012: Preface; Shapiro et al. 2015).

The editors of *Water, Cultural Diversity, and Global Environmental Change* (Johnston et al. 2012) note that for IWRM to create truly sustainable resource management, it will need to

incorporate the less quantifiable values related to water in the local context. As a mechanism to guide water development that incorporates both human and ecosystem needs, IWRM places economic values and aesthetic values on water use, translating into the minimum requirements to maintain human/ecosystem integrity, which are referred to as *environmental flows*. They argue that cultural diversity, or *cultural flows* as the authors refer to it, should be considered within the framework as well to produce a sustainable water system.

The above recommendations are made with what appears to be a clear sense of who is being excluded from the planning process and whose needs are not considered and may be overly simplistic in a politically dynamic context. Breslow (2014) discusses the complexity of developing ecosystem restoration in a region with both farmers and Indigenous fishing communities making claims to the local landscape in the northwestern part of the United States. Each makes their claims through their ties to the land and "Both have been co-constructed with the natural resources on which they depend, such that their resource-based livelihoods are integral parts of their cultural identities" (Breslow 2014:742). This emphasizes how communities are not static or unchanging, but diverse and in flux, which adds to the challenges of building multivocality into water resource management.

Research suggests that water resource management can benefit from including multivocality in the decision-making framework (Canton and Orlove 2010:410). In response to the lack of multivocality in water resource management, Cantor and Orlove (2010) and Wells et al. (2014a) recommend that future research increasingly interrogate who is speaking, and investigate the politics between practice and conceptualization in the wastewater decision-making process. My research considers the contrasting perspectives related to water, energy, and utility vulnerability. I investigate the various stakeholder perspectives and their various levels of

consensus within a cultural model and political ecology framework. I understand water as a "total social fact" (Orlove and Canton 2011) that incorporates an understanding of water as both socially abstract and physically concrete.

Political Ecology and Energy

The anthropological exploration of culture, power, and energy has collapsed the distinction between humans and nature by placing energy concerns within the same environmental degradation framework as water resources. Energy resources and the human-environment relationship have similar concerns with power and nature. The literature concerning water and energy argues that they are interrelated resources that are increasingly becoming challenges to sustainable development. Water and energy are tied together, making resource scarcity in one felt in the production of the other (Rio Carrillo 2009). The power sector is one of the more substantial draws on water resources, and if water quality, quantity and accessibility declines, reliable, affordable and sustainable energy also becomes limited. Conceptualizing water and energy as a nexus treat them as interlinked through their use and the infrastructures built to facilitate their distribution and consumption (Scott et al. 2011). Anthropology contributes to an understanding of the water-energy nexus by extending research to include not only the physical utility structures, but also the intersections of the water-energy nexus, cultural models, and the environment (Wells et al. 2014a).

Laura Nadar (2013) when referring to where anthropology and energy are heading, argues that by engaging in anthropological study from various directions, "up, down, and sideways", we learn who the primary actors are, and therefore can no longer see humans as separate from nature. Furthermore, through an investigation of energy development's paradigm - progress, we can reveal differential distribution of social power. More interesting is

anthropology's contribution to the long-term perspective of the human-energy relationship. A valuable question would be how do humans solve the problem of finite material resources? This question is relevant to an anthropological investigation of water, energy and sustainable disaster development because water and energy cannot be separated from humans (Nader 2013:320). Energy-human relationships are also explored by anthropologists within the notion of power, biology, and governments, framing these aspects within management and control of human vitality through expert and authoritative interventions of health, security, and population.

Building on Foucault's (2004) work regarding biopolitics and governmentality is anthropologist Boyer's (2014) argument for extending it to include "energopolitics" or "energopower". Energopower refers to the harnessing of electricity and fuel for human purposes (Boyer 2014), and is connected to biopower, or the management of life and populations (Foucault 2004). Boyer (2014) challenges scholarship to expand biopower's anthropocentric focus of intervention and remediation to include "increasing recognition that conditions of life today are increasingly and unstably intertwined with particular infrastructures, magnitudes, and habits of using electricity and fuel" (Boyer 2014:323). Energopower is a means to investigate political power through electricity and fuel, looking deeper into the pipes, poles, and power lines to uncover the ways political power and energy converge to create how we perceive and experience energy, and I would argue, water and disaster management as well.

Moreover, anthropological exploration of energy and society has begun to interrogate how they relate to the environment, "that space in which the consequences energy use play themselves out and which also constitutes the space of origin of all forms of energy" (Szeman 2014). It is useful for my political-ecology based research to situate the local St. Thomas energy and water utilities, development policies, and disaster vulnerability within a similar approach,

placing the human-environment relationship within the same exploratory framework as energy and politics.

Authoritative Knowledge and Local Knowledge

Paulson and Gezon note that "not all knowledges or technologies enjoy equal power, raising questions about how and why particular interests and values predominate and how power circulates in ways that influence biophysical or social outcomes" (2005:11). A political ecology perspective highlights the privileging of technological and scientific knowledge developed through academic and institutional processes over LK systems that are based on generational observations and experiences, and that are often distributed throughout a community through oral history and other forms of knowledge sharing. Moreover, Indigenous or local knowledge comprises a body of knowledge held by local people and built upon over time through a society-nature relationship, shared practices and institutions, accumulated experiences, and passed along through generations (Mercer et al. 2010). LK is often associated with bottom-up development processes, while AK is associated with top-down approaches to resource management.

AK and decision-making have been explored in a variety of contexts, from child birth (Jordan 1992) to wastewater management (Alley 2006, 2012), ecosystem management (Giebels 2014) and disaster anthropology (Button 2010). AK has been described as that knowledge recognized and claimed to be the relevant knowledge for a particular situation. Scholars contributing to the understanding of LK and political ecology (Breslow 2014; Schroeder 2006); disaster (Lauer, 2012; Mercer 2010; Bankoff et al. 2015; and Button 2010) and water/wastewater (Izugbara et al. 2004; Alley 2006, 2012), public health (Manderson and Whiteford 2000) have investigated how AK is constituted in a given situation and have shown that although techno-science typically achieves AK status, there are complex processes involved with how authority is

recognized and enacted in the local context. Locally, techno-scientific knowledge can be viewed with distrust or it can be made to fit with existing knowledge structures. One way to actively and deliberately create inclusivity for LK is through participatory projects.

An outcome of attending to LK and AK in sustainable water and energy management is to promote collaborative or participatory projects. Participation entails incorporating diverse community stakeholders from the community in the decision-making process. Inquiring about Indigenous (Izugbara and Umoh 2004) or local wastewater systems can provide a unique opportunity to broaden the wastewater knowledge base. Incorporating LK into the broader understanding of wastewater and disaster is thought to foster empowerment of marginalized people, but there are challenges to doing so. Scholars (Berry and Mollard 2010, Brugnach and Ingram 2012) have discussed how inclusion of people from the local community in water related projects has become part of the overall water resource management paradigm. They caution, though, that despite LK being a part of the decision-making framework, it does not necessarily mean that the needs of all members of the community are met. Brugnach and Ingram question whether the new participatory water resource management process includes local people in the decision-making process, since it still relies on a model that embraces a paradigm based on the control of natural systems through technical solutions produced from "expert information" (2012: 61).

Similarly, Berry and Mollard argue that social participation is "inherently political" (2010: xxi). If the participatory process is intended to allow for stakeholders to influence the decisions made related to development initiatives, how does the process allow for inclusion of the interests of those directly involved and those outside the development sphere (Berry and Mollard 2010)? Regarding water management, social participation allows for individuals or

collectives to present their point of view publicly. There are different levels of participation, from simply publicly presenting their perspective to demanding full inclusion in decisions and implementation. The latter tend to place importance on empowerment, focus on marginalized groups within a society, indicate distrust of the state, and emphasize LK as a relevant contribution to the development agenda (Berry and Mollard 2010).

The challenge is how to make divergent knowledges compatible with resource management in general, and how best to dissolve the gap between AK and LK. Within the disaster field Cadag et al. (2012) argue that scientific knowledge has been unable to keep pace with the increasing frequency of disasters but also note that disaster risk reduction (DRR) is not experiencing the same failure. Sustainable DRR can best be achieved through collaboration between stakeholders, such as government authorities, non-government organizations (NGOs), scientists, schools and faith-based groups. Community-based and people-led DRR occurs from the bottom-up, with scientists and government authorities having the potential to facilitate sustainable livelihoods through support and protection (Cadag et al. 2012). Additionally, knowledge sharing between each stakeholder is important in DRR, "local knowledge is invaluable in understanding historical hazard events while scientific knowledge has been proven to be of great importance when dealing with rare or unprecedented events (Cadag 2012:100).

It is important to see that despite empowerment being built into the political ecology framework; it can be challenging to create such spaces. Scientific knowledge and technology are very relevant to how we solve disaster, energy and water problems, but as history has shown, development approaches that rely solely on these epistemology and ontology may simply maintain existing power dynamics, reducing long term water and energy management sustainability.

A potential way to bridge the divide between LK (also known as Indigenous knowledge) and AK (or scientific knowledge) can be what Mercer et al. (2010) describe as a "process framework" that sees the process of getting to the outcomes being just as important as the outcomes themselves. This can be a means to "achieving a just and sustainable outcome in substantive, emotional, and…, and procedural terms" (Mercer et al. 2010:219). This framework identifies Indigenous and scientific strategies based on the same criteria, and sees equal value in both knowledge systems, with the outcome being reduced vulnerability.

Furthermore, the devaluating and loss of LK coping practices increases social vulnerability (Wisner 2004). For Wisner (2004) the assessment of a community's vulnerability not only involves determining LK related to disasters in the community but also creates a space for subaltern voices and stories, creating a point at which the community benefits by fostering greater equality. Wisner argues that what is needed is "an understanding of why and how local knowledge is rendered inappropriate or inaccessible, and the ways in which people can be empowered to reclaim local knowledge and appreciate its usefulness" (2004:188). Such research can reveal the political dynamics that result in, over time, marginalized groups losing a connection to and knowledge of their local environment and resources. Furthermore, community vulnerability assessment that incorporates LK can enable local community groups to regain lost environmental connections and knowledge.

In the St. Thomas context, Barbara Rose Johnston argues that prior to tourism growth local families engaged in fishing and swidden cultivation practices to meet their household food needs (Johnston 1987, 1994). Johnston notes that despite the U.S. census description of nonurban, non-agricultural acreages as non-productive "woodland", people were in fact utilizing the woods to make charcoal, raise pigs and goats, gather a variety of herbs, berries, and fruit, and

hunt deer, pigeon, and duck (1994:201). Currently, most St. Thomas residents shop for food at local markets and supermarkets that import products from other countries. The cost of producing locally is often more expensive than the price of produce in the stores. Added to the production expense is the high cost of land and it means there are not many who are able to produce food commercially on their own land (Johnston 1994).

This disconnect is not just a physical one but is reflected in the loss of environmental knowledge through a lack of interaction with the environment. Two generations of government and tourism employment have led to an environmental disconnect for many residents. Johnstone notes that "coastal resort development has meant restricted access to many beaches and near shore marine resources. Many native Virgin Islanders lack the skills to sail, operate a motorboat, or even swim in the warm waters where a million or more tourist frolic each year" (1994:201). Moreover, this economic development has increased water shortages and produced insufficient sewage and waste treatment.

Previous anthropological scholarship addressing the Caribbean region and coastal resource management (Stoeffle 2007) has shown that the federal systems are not the best approach to resource management in the U.S. Virgin Islands (Johnston 1994, 1998; Grace-McCaskey 2012). Those with the authority to make decisions regarding resource management may be doing so from a perspective that is disconnected from how the local resource users relate to them. The literature suggests this gap exists because of inequalities in the community, and my research builds on that understanding by showing to what extent during the planning and management process the authoritative voices rely on knowledge not only captured at the local level, but also knowledge from diverse groups within the community. Developing an

understanding of AK and LK will broaden an appreciation of risk perception, vulnerability, and governmental agencies.

Disasters and Anthropology

Like the water and energy scholarship, the disaster literature emphasizes the dynamic relationship among cultural beliefs and practices, the environment, humans and politically enforced social patterns that create vulnerability to disaster (Oliver-Smith 1996, 2004; Hilhorst and Bankoff 2004; Donner 2007). In the disaster setting, political ecology is a framework for understanding the historical, social, cultural, economic, institutional, and political structures influencing how people are impacted locally by a disaster event (López-Marrero and Wisner 2012). Within disaster research vulnerability is seen as a fundamentally political ecology concept that binds together the human-environment relationship through cultural values that sustain or contest social forces and institutions (Oliver-Smith 2004).

Assessing Vulnerability

Risk and vulnerability can be assessed from a human geography perspective. Wisner (2004) breaks down these assessments into demographic, taxonomical, situational, and contextual. The Demographic Approach assesses human vulnerability and capacity along with many other community characteristics, such as buildings, bridges and health care systems, often resulting in people being lost in the focus on broader systems (Winser 2004). For example, concentrating on the placement of a tsunami warning siren system along the coastline fails to consider those who are hearing impaired. It is deemed that the warning system is useful to the inhabitants of the Caribbean island without considering the community diversity. Similarly, the focus on reducing energy vulnerability by clearing a large area of land for a solar power array can potentially disenfranchise people who use the area for subsistence or recreational purposes.

The intent is to reduce community vulnerability and build capacity, but the unintended consequences might be that these development solutions marginalize people in the community by denying them access to resources needed for daily life. This is the approach many disaster and emergency management agencies have historically relied on, and can be seen today in such examples as the U.S. Virgin Islands VITEMA 2014 Territorial Hazard Mitigation Plan (VITEMA 2014) that focuses on only two vulnerable demographic groupings, residents under the age of 18 and those over the age of 65 when evaluating community vulnerability. The document is more concerned with structures and financial losses than the vulnerability of specific groups.

The Taxonomic Approach groups people by certain characteristics, like gender, health, age, ethnicity, race, disability, religion, and socio-economic status. Organizations and institutions assess the vulnerability associated with these characteristics and determine the group's special needs. Wisner (2004) notes that the lists produced by this approach are useful, especially in a chaotic post-disaster environment, but these groupings and their vulnerabilities do not address causation. How and why are certain groups in a community more susceptible to death, livelihood disruption or injury (Wisner 2004)? Being able to determine that isolated elderly people are more likely to suffer during a heatwave in a city is useful, but unless we can learn why they are more vulnerable during this disaster event, we are not able to build community capacity and resilience.

Another approach to assessing vulnerability relies on an understanding of the daily lives of people in the community. This situational approach understands that disasters create the setting in which already existing daily life vulnerabilities are extended and amplified. Within tis approach vulnerabilities are considered fluid and not consistently tied to a particular group over time and space. This suggests people in a community are differentially vulnerable depending on

the type of hazard (Wisner 2004). In the Caribbean region, tourists may be more susceptible to a flooding event because they are not familiar with the local topography and the areas prone to flooding. As well, certain hazards may be a threat during different periods of a person's or group's life cycle and daily life. For example, at times of year or a person's age. A child might have less agency and be dependent on access to resources and power.

Situational analysis recognizes intersectionality of characteristics. This refers to the multiple aspects that combine to create marginality and vulnerability. In the case of a Caribbean community, the overlap of having a low income and being a woman who is a single parent might produce pre-existing vulnerabilities that become enhanced during and after a hurricane. She may not have the resources needed to access disaster assistance, like a car. On a mountainous island like St. Thomas a car is almost a necessity and there are residents living in low income, high density areas that lack an automobile, and who infrequently or never travel to other parts of the island. This lack of mobility can make it challenging for them to access capacity building resources, attend disaster planning meetings, and get to safety if necessary. Likewise, an emergency warning system that sends messages only in English means that language becomes a barrier to a group's safety. St. Thomas is a diverse island with one segment of the community who only speak and understand Spanish, who earn a very low income, and have limited access to government resources, leading to their increased vulnerability during and after a disaster event.

Similarly, recent work done by Atyia Martin (2014) who presented at an Environmental Justice Joint Working Group information event that was attended by FEMA, HUD, community emergency management and public health agency representatives, shows that certain social characteristics, when they intersect, create greater social vulnerability. Martin's (2014) Social Determinants of Vulnerability Framework developed from link analysis of the literature, stresses

the links between civil rights and social vulnerability resulting in poor outcomes in the event of an emergency situation. This research found that when the framework was applied to the city of Boston there were a number of interrelated social factors that influence vulnerability, that included children, people with disabilities, older adults, those who were socially isolated, had low-to-no income, were renting a home, did not have access to a car, and were people of color. Although Martin's research adopts aspects of the situational approach by looking at how factors correlate, it is primarily taxonomic in that it does not show causation. In order to reduce social vulnerability, we should be looking for ways to funnel power to those who are found to be socially vulnerable.

The fourth assessment approach involves community led assessment practices and is what Wisner calls "a contextual and proactive approach" (2004:187). Groups within the community take the lead on determining their own capabilities and vulnerabilities, rather than outsiders. They may utilize taxonomic and situational tools similar to outside professionals, but the difference is that it is local community members who determine how they are used, what is a risk and what is not. Residents would employ the social vulnerability concept which "involves a thorough analysis with, and by, the residents of their own resources and capacities/capabilities" (Wisner 2004:187), as well as their risks and vulnerabilities. The contextual and proactive approach has the potential to mitigate disaster vulnerability by addressing existing power imbalances in a community, giving local people the ability to assert their position and have a say in disaster planning. Furthermore, it places value on the ability of the members of a community to evaluate and determine best practices related to their own lived experiences.

FEMA's Whole Community approach to reducing disaster vulnerability employs aspects of the contextual and proactive approach along with some situational factors. At one level, the

Whole Community framework draws on a variety of community resources, organizations, and members in emergency management and planning, and there is some support for community-based projects that reduce vulnerability. At another level, management and planning are directed by an overarching agency. The FEMA (2011) literature lists these strategies within the Whole Community framework:

Whole Community Strategic Themes:

- Understand community complexity.
- Recognize community capabilities and needs.
- Foster relationships with community leaders.
- Build and maintain partnerships.
- Empower local action.
- Leverage and strengthen social infrastructure, networks, and assets.

This framework operationalizes community relationships and draws on existing social capital, resources, and institutions. It stresses that communities are diverse and that different members have different capabilities and needs. Under Recognizing community capabilities and needs, FEMA suggests employing a participatory mapping activity as a way to engage with community members about their knowledge of local assets and vulnerabilities. Collaborative mapping can achieve one of Wisner's (2004) suggestions regarding the need for community groups to be empowered through the disaster planning process, but this approach does not really address the political dynamics in the community and the very real challenges to including diverse populations into one overarching emergency plan. There is a recommendation that much of the pre-disaster community work makes the overall community less vulnerable to a disaster event,

but FEMA does not discuss in any meaningful way marginalization of certain groups in a society and how to eliminate inequalities in communities.

Pressure and Release Model

Conceptually, vulnerability is a framework that accounts for how disasters impact all human life, that includes the environment, social, economic, political, biological vulnerabilities and the multidimensionality of disasters. It is a causal chain of different forms of vulnerability, which is represented in the Pressure and Release (PaR) model developed by Ben Wisner, Piers Blaikie, Terry Cannon, and Ian Davis's (1994; 2004; 2012). The PaR model provides a way to conceptualize how hazards become disasters within the political ecology framework. Wisner et al. argue that to fully understand the causation of disaster, we need to show how normal historical processes contribute to vulnerability (1994:18), and the PaR model is based on the idea of the social production of vulnerability (Wisner et al. 1994: 45).

PaR framework models how disasters occur at the intersection of two opposing forces – vulnerability generating processes on one side and natural hazards on the other. Pressure on people comes from the vulnerability processes with three sets of links at various distances connecting disaster to people. These links include ideologies, dynamic processes, and unsafe conditions. A model that generalizes how vulnerability and disasters intersect with the political and ecological can reveal the links between ideologies, dynamic processes and unsafe conditions. It is our vulnerability to disasters that show us the complex material, social and ideological contexts and processes.

There are limits to what we can know through the PaR model. Oliver-Smith (2004) notes that Blaikie et al. (1994) acknowledge that the PaR model does not allow easy identification of linkages between unsafe conditions to specific dynamic pressures, making causation of specific

events challenging to recognize. Seeing the links, through vulnerability, between social, economic structures, cultural norms and values, and environmental hazards does not tell us how the forms, organizations and beliefs produce that environment (Oliver-Smith 2004). Oliver-Smith proposes unpacking the theory of vulnerability to further understand how disasters are a product of society and less of nature. Moreover, he argues that risk perception is not purely a semiotic process and something that is socially constructed, but that the "physical existence of disasters establishes an agency of nature that exits independently of human perception" (Smith 2004:17). The mutuality of nature and culture becomes apparent when discussing disaster vulnerability, "the mutual construction of human beings and environments provides a theoretical basis for asserting that we construct our own disasters insofar as disasters occur in the environments that we produce" (Oliver-Smith 2004:18). Disasters highlight that human societies and natural systems have a co-evolutionary relationship. Through the lens of vulnerability, we can see this relationship, as it is shown through the existence of vulnerability that societies and nature combine to produce uncertainty.

When exploring how vulnerability to disasters materializes in the insular Caribbean, López-Marrero and Wisner (2012) argue that depending on the Caribbean nation, there is differential vulnerability to disasters, and note that all are "not in the same boat" (López-Marrero and Wisner 2012) despite being from the same geographic region. For example, the differential ability of Haiti to recover after the 2010 earthquake and Cuba's recovery after Hurricane Georges in 1998 show that local context matter. Haiti received a devastating blow when the earthquake occurred, resulting in 217,000 deaths and massive destruction. It is well documented that the country continues to struggle with the effects. Cuba, on the other hand, lost six people after the 1998 hurricane and was able to quickly recover. López-Marrero and Wisner (2012) argue that in

general, despite both countries experiencing high numbers of disasters between 1980 and 2009, Cuba has been able to rebound at a greater rate. Despite having one of the lowest GDPs per capita and U.S. imposed trade blockade, Cuba has developed effective risk reduction and disaster management, that includes considering disaster and risk management as similar entities and as part of the overall development of the country. Risk reduction and disaster management are approached in the same ways as access to universal health care and education (urban and rural), policies to reduce disparities, and building the country's infrastructure (rural and urban), resulting in a "Progression of Safety" (Wisner et al. 2012),

Those Caribbean islands experiencing political instability and poverty may have less capacity as these factors contribute to a society's overall vulnerability to disaster events, and therefore, each island nation has differential coping capacities. Figure 6 shows how López-Marrero and Wisner (2012) view capacity to recover after a disaster event.

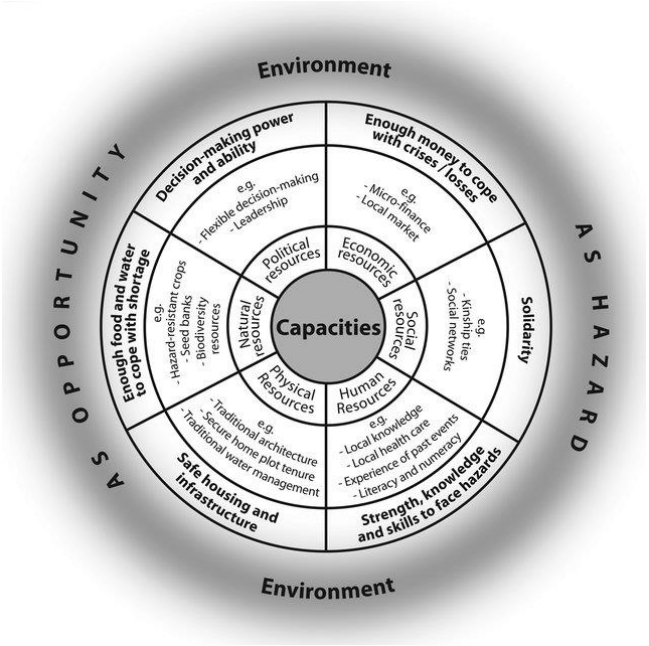

Figure 6. The Circle of Capacity from Wisner, Gaillard and Kelman 2012

Capacity is developed by building on social, economic, political, natural, physical, and human resources. In the context of the Caribbean, these capacities can be differentially distributed, as highlighted by the contrasts between how Haiti and Cuba respond to disasters. Conversely, this way of conceptualizing the relationship between the environment and capacity enhancement represents the environment as outside of the various human-centered elements that enhance capacity, and does not show how, like Oliver-Smith (2004) suggests, the various linkages that create greater capacity. Building in an understanding of the human-nature relationship may make this model more useful to learning how capacity is built.

Risk and Vulnerability

There are a variety of means to evaluate risk and vulnerability. The research approach may be different depending on what material aspect you are investigating, for example, a utility infrastructure, or whether you are interested in cognizant processes producing risk perception, or even a combination of these aspects of risk perception. Risk and vulnerability are becoming increasingly important to understanding how to mitigate slow onset disasters, such as the effects felt from climate change, and sudden disaster impacts felt from hurricanes and volcanoes for example (Birkmann 2007; Wisner 2004).

Risk Perceptions

Risk perception has been the focus of a variety of social science disciplines and involve different approaches; from interest in the relationship between specific indicators, like gender and age, to risk perception (Jones et al. 2013), to the cascading impacts of disaster-prone areas and risk perception (Tobin et al. 2007), to how risk perception is related to acute versus chronic exposure to disasters (Tobin et al. 2011). Birkmann et al. (2013) call for research that focuses on integrating an understanding of both the social-cultural perceptions of risk and vulnerability, as

well as local infrastructure risk. To contribute to disaster risk management, research should consider the social construction of risk. Included in the overall understanding of disasters as the product of the relationship between the physical environment and society are "a society's behavior, function, organization and development, including human perceptions" (Birkmann 2013:196). For my research purposes, I am interested in intersection of human perceptions, social and infrastructure vulnerability and risk.

In this context, vulnerability is described as "being susceptible to loss, damage, and injury. The characteristics of a person or group and their situation that influences their capacity to anticipate, cope with, resist, and recover from the impact of a disaster" (López-Marrero and Wisner 2012:133). Additionally, vulnerability refers to what degree such aspects as physical and capital assets, humans and their livelihoods, experience harm and damages when confronted by a one-time disaster event or compounded events (Birkmann 2013:195). Risk and vulnerability are assessed through models and frameworks that account for not only the physical environment, but include the social, political, and ecological at multiple scales.

The anthropological approach to understanding risk perceptions is based on a cultural framework. Risk perception is seen as a "process of implementation of norms, values, and cultural practices within a group of people" (Jones et al. 2013:8). The interest is in how beliefs and practices related to risk and vulnerability are reflected by people, and how they are collective constructs (Douglas and Wildavsky 1983). Risk perceptions become relevant when attempting to understand how cognitive processes manifest in responses to disasters. The question is how people's perceptions translate into policies, practices, and actions. Moreover, a cultural approach to understanding risk perception attempts to "discover what different characteristics of social life elicit different responses to danger" (Douglas and Wildavsky 1983:8). Risk perception research

on St. Thomas enquires into how people's perceptions of the risks to their local watershed and utility infrastructure are reflected in policy and sustainable development. Drawing on work done related to a cultural model approach, my research provides a means to contextualize the physical risks identified within the larger political ecology framework.

Infrastructures and Anthropology

My research questions incorporate investigation of wastewater, water, and energy utility infrastructures. Addressing (waste) water, energy, and disaster vulnerability requires further analysis of how infrastructures are developed, are constituted, and perceived within the community. Within anthropology infrastructures are described as:

> not a specific class of artifact or system, but an ongoing process of relationship building. Seen in this way, engineered canals and highways are surprisingly social and ecological. As temporary lines across active environments that erode, rust, and fracture them, infrastructures advance and retreat in relation to the capital and labor channeled into their construction and maintenance. (Carse 2014:5)

The shifting nature of infrastructures, whether they are built to support a labor force for the capitalist endeavor by keeping bodies healthy (Whiteford 2005), or to give citizens early warning of impending disaster (Choi 2015; Collier 2015), are inherently tied to politics, economics, and the environment. Anthropology has found it difficult to ethnographically analyze technological systems, focusing on how infrastructures influence the local community, and not looking into the infrastructure-built network (Larkin 2013). Veronica Strang (2016) argues that water infrastructures specifically are susceptible to potential ‘despotic’ control through privatisation and the public-private partnerships increasingly developed to manage infrastructures: “I think there is also a risk that locating the ownership of vital water resources in transnational elites, and failing to regulate their activities effectively, has the potential to lead to 'despotic' behaviours in

which local social and ecological rights and interests can be ignored with impunity (Strang 2016:295). In the context of the USVI, Veolia North America is the private international corporation that worked with the USVI on two wastewater infrastructure projects, one on St. Thomas and the other on St. Croix, with a goal to address issues outlined in a U.S. Environmental Protection Agency 1996 report. As noted previously, within the political ecology framework, it is important to investigate the global-local power dynamics that result as a consequence of infrastructure development, and whether they are creating a barrier for residents in the community to access resources like water and energy. Through these investigations we can see who is part of the decision-making process.

Infrastructures are ontologically challenging to grasp as they are things that permit other things to move. They have a relational quality, as the means for the movement of matter, but are also matter themselves. Often invisible, we see the light but not the electricity, we experience the water, but do not see the pipes or sewers that permit its movement (Larkin 2013). I argue that invisibility decreases at the moment a disaster event occurs. Citizens become acutely aware of the deficiencies in their infrastructures and begin to evaluate their vulnerabilities, leading to the post-disaster focus on "Building Back Better".

Building Back Better

The concept of Building Back Better (BBB) is a phrase seen often in news reports and policy recommendations (UNISDR 2017) in the post-disaster environment. It usually refers to the period immediately after a disaster in which there is reflection on how to reduce disaster vulnerability and fortify against the next catastrophic event. The sense is that a community can make changes during the rebuilding time that will enable it to withstand the destructive impacts of future disasters. The Sendai Framework for Disaster Reduction outlines sixteen "prerequisites

for recovery" (Wisner 2017) and recommendations for development that have the goal of creating a more resilient community. Wisner (2017) in his work provides a critical perspective of the BBB approach and the Sendai Framework specifically, and summarizes their key factors to be considered when developing community disaster resilience as follows:

- Government: adequate national scale laws, regulations, codes, institutions, uniform risk and vulnerability assessment procedures
- Economy: provision for economic measures such as insurance and the risk sharing, public-private finance for construction/re-construction of safe school, hospital and other essential infrastructure, support for business resilience (including tourism) and plans for recovery of lost or interrupted livelihoods
- Ecology: conservation of natural ecosystem including those that support cites, land use planning and measures to reverse land degradation
- Human Settlement: in situ protection of human settlements and arrangements in advance to act as hosts if necessary, to an influx of people displaced from somewhere else, tailing building and land use codes to be feasible in informal settlements
- Safety Nets & Essential Services: attention to health care, maternal health care, food security, nutrition and housing
- Vulnerable Groups: care of people with special needs such as those with chronic diseases.

Wisner (2017) argues that due to the complexities of societies, the BBB approach based on the six categories above should not begin with the catastrophic "triggering event". For example, simply focusing on the earthquake event and post-disaster recovery in Haiti ignores the pre-disaster reality influenced by weak governance, conflict and reliance on external resources provided by donors and experts.

Wisner (2017) and others (Di Giovanni 2017; Khasalamwa 2009) have provided a critical perspective of adopting a BBB approach to disaster recovery and vulnerability that argue for a broader perspective that recognizes the complexities of pre-disaster societies. They question if it is possible to build disaster resilience into post-disaster recovery if there are pre-existing political, economic, and ecological instability and vulnerability?

Chapter Summary

In this chapter I establish the theoretical framework that is the foundation for my dissertation research. As a theoretical framework, political ecology is concerned with political, cultural, and environmental processes, and the global-local articulation of them. This framework allows me to incorporate divergent knowledge scales, local and authoritative into a cultural model that contributes to an understanding of political ecology, the water-energy nexus, and the community vulnerability bodies of work. The preceding review of the literature related to political ecology, water, wastewater, and energy will enable me to discuss the multi-scale social, political, and environmental factors that impact resource decisions and access in the USVI. The literature concerned with AK and LK, disaster vulnerability and risk, and infrastructures shows the complexity of multiple relationships and dynamic processes that, when combined, can influence community vulnerability and resilience. Furthermore, the political ecology framework allows me to address the need for a nuanced ethnographic exploration of the water-energy nexus, disaster vulnerability perceptions, and the political forces shaping local policies. Finally, as the literature shows, there are far reaching impacts from collaborative and participatory disaster and resource management/planning, providing a point for my research to explore the social and political processes that produce inclusion or exclusion in St. Thomas disaster, wastewater, energy and water policy development. In the next chapter I describe the local St. Thomas setting,

situating the historical and current water, wastewater, energy infrastructures, disaster vulnerability, and coastal resource management in relation to disaster vulnerability and the water-energy nexus.

CHAPER THREE: SETTING

Chapter Overview

St. Thomas an island that forms part of the United States Virgin Islands, is located 40 miles east of Puerto Rico (also a U.S. territory) and 1,000 miles southeast of Miami (Figure 7). The island is a location that lends itself to an exploration of the relationship between multiple scales of authority and knowledge, risk and vulnerability perception, and wastewater and energy utilities. As a Caribbean island territory of the United States, the U.S. Virgin Islands are the outcome of the colonial and post-colonial processes on an island with political and economic ties to the U.S. It is a location that can inform an understanding of how being a U.S. territory intersects with local geophysical and climatological hazards that can produce disaster vulnerability. I begin this chapter with a physical description of St. Thomas that establishes the grounds for further discussion of the natural hazards and history of disasters in the territory. The next section contains a brief overview of the pre-colonial, colonial, and neocolonial periods, the demographics and local economy that provides an anchor for my discussion of current water, energy, wastewater and disaster vulnerability within the political-ecology framework.

St. Thomas Characteristics

The U.S. Virgin Islands are part of a volcanic mountain chain. St. Thomas' rise from sea level is 1,556 feet, and the island has a land area of 28.25 square miles. There are no permanently flowing rivers, but intermittent streams, also referred to as "guts", become fast flowing waterways during intense rainfall. Most of the annual average rainfall of 40 inches occurs during hurricane season, which is June to November. The central part of the island has a large aquifer,

but water quality is an issue, a factor I discuss in more detail later in this chapter. The climate is typical of a Caribbean island, with seasons dividing along wet and dry. On average the months between December and May are dry and have temperatures between mid-70s to mid-80s with warm, typically clear days, and coincide with the high tourist season. The months between June and November are the wet, muggy months that produce frequent storms. Temperatures range from high 70s to low 90s during that time of year. The north side of the island typically sees more rainfall and the east end is known to be drier. The island has been experiencing a period of reduced rainfall, creating vulnerability to drought. While there is less rainfall, the intensity of storms appears to be increasing as shown by 2017s back to back hurricanes, Irma and Maria. These are factors that contributed to my sampling selection for data collection because they influence people's wastewater, water and energy behaviors. These geophysical and climatological characteristics work in conjunction with political, environmental and economic processes, and water-energy infrastructures to produce vulnerability to disaster (Wisner et al 1994).

Historical Periods

Pre-Colonial Period

Archaeological findings indicate that prior to European contact in the Caribbean, Indigenous groups migrated between islands, and utilized various ecological adaptations to subsist in their new environment. Building on subsequent culture groups and movements of people within the region dating to around 6,000 years ago (Wilson 1997), cultural groups like the Arawak (also referred to as Taino) and later the Carib, emerged as the predominant cultures existing in what is the U.S. Virgin Islands today (Dookhan 1994). Historian, Isaac Dookhan notes "Ciboneys entered the Virgin Islands between 300 and 400 B.C. and the Arawaks arrived

at about 100 to 200 A.D., it has been estimated that the Caribs who were advancing behind the Arawaks reached here about 100 to 150 years before the arrival of Columbus" (1994:16). These waves of inhabitants to the islands found the local environment provided the resources they required as hunter-gatherers, and there are those today who identify as decedents of these earlier culture groups.

Colonial Period

The colonial period laid the foundation for future transnational economic and political connections between Europe and the Caribbean. Columbus first encountered the Virgin Islands in 1493, at which point Spain asserted exclusive rights. Throughout the subsequent centuries the islands would be claimed at various times by the French, English, Spanish and Dutch. Denmark established a colony on St. Thomas in 1672 and formed the Danish West Indies, which was maintained until the sale of the Virgin Islands in 1917 to the United States (Dookhan 1994). St. Thomas was a desirable place to colonize due to its strategic location for trade with the surrounding Spanish, French and English colonies. Although trade was a driving force, agricultural pursuits soon became the impetus for colonial economic expansion in the Virgin Islands. To understand the political ecology of the territories requires considering the long colonial history

The colonial period was characterized by first the unsuccessful enslavement of local Indigenous peoples (many dying due to disease and poor working conditions) in order to extract gold for Spanish coffers; then by the development of plantation economies based on sugar, tobacco, and cotton; the intensification of slavery, and finally the period of emancipation (Boyer 2010; Dookhan 1994; Grace-McCaskey 2012; Johnston 1987, 1994, 198l Mintz 1996). Anthropologist Sidney Mintz, writing of the colonial relationship between the Caribbean region

and Europe, describes the agro-plantation enterprise as "vital to the reshaping of both food habits and forms of leisure of massive urban European populations, [and] were landmark experiments in modernity" (Mintz 1996:295). These early exploitative relationships established later interrelations that are reflected in the current St. Thomas context. The period of European colonization between the 1700s and 1900s, produced marginalized communities, usually made up of those removed from their homeland for the slave markets, in relation to those who controlled not only people but resources throughout the world. This provided a foundation for capitalism's growth and fostered further division between those who control the means of production and those whose labor was exploited for capital gains (Escobar 2012, Mintz 1996). Intricately tied to colonization, slavery as an enterprise became crucial to the agro-plantation system.

The decimation of the Indigenous population in the U.S. Virgin Islands prompted the exploitative removal and transportation of people from Africa to provide the labor that drove the colonial economy. During this period of time more foreign national planters moved to the Virgin Islands. They would become the plantation owners, contributing to the diverse community make-up, but with white European people predominantly the powerful and black African people holding subjugated positions in the society. The subjugation of the African-Caribbean people caused tensions, leading to push back against the colonial authority that propelled the islands closer to emancipation. A series of slave revolts between 1733 and 1848 eventually resulted in emancipation, but the struggles continued for African-Caribbean people in the islands. The plantation economy still existed, and the worker-plantation owner relationship remained strained, but emancipation meant that previously enslaved individuals had some choice in how they made a living.

The new post-emancipation labor system created social instability and economic dislocation because of poor preparation by the plantation owners for the newly created employee status of former slaves. This ushered in a period that is described as moving from "slavery to serfdom" (Boyer 2010). The contract system set up to ensure agricultural employers had the labor they needed were often seen by the workers as another form of slavery. Labor revolts were common, producing strains on agricultural development and leading to a series of economic downturns, and finally the sale of the Virgin Islands to the U.S. in 1917 (Doohkan 1994; Grace-McCaskey 2012).

Religion was a constant and mobilizing factor throughout the colonial emancipation period. Religion was a prominent factor in people's lives during the colonial period and continues to be an important institution in people's lives on St. Thomas. The Moravian church I attended on St. Thomas is the oldest known in the Caribbean, with a long history of providing support to those marginalized in the community. Moravian Christianity based in Europe was first established in the Danish West Indies in 1732, and was one of the first Christian faiths to actively proselytize in the Caribbean with a focus on drawing Christian slaves into their congregations. Missionaries first arrived on St. Thomas and St. John in what is today the U.S. Virgin Islands (Thorp 1998). The mission quickly spread throughout the region and today there are many Moravian church congregations in the Caribbean.

Post-colonial Period – Being a U.S. Territory

The contemporary St. Thomas socioeconomic, political, and ecological context are deeply rooted in early colonial relationships between the Caribbean and colonial powers. The colonial relationships were the foundation for current economic marginalization and environmental degradation on the island. Declining economic conditions leading up to the 20th

century was the impetus for the sale of the Virgin Islands to the U.S. As distant colonial land holdings, they were not considered valuable by the Danish government. There was little incentive to ensure the local people's well-being, resulting in poor living conditions and poverty for those without ties to capital enterprises. The Danish colony struggled to maintain its control of the islands and began negotiations with the U.S. for their purchase. The U.S. recognized the USVI militarily strategic location in the Caribbean and appreciated the deep, calm waters of Charlotte Amalie harbor. Characteristics that made the harbor on St. Thomas favourable for docking large ships. The price was set at $25 million, and when it was paid in 1917, marked the new U.S. colonial period (Boyer 2010, Dookhan 1994, Grace-McCaskey 2012, Sekou 1994). Once control of the islands transferred to the U.S., they were under the control of the U.S. Navy, who implemented such achievements as a sewage removal system, education system, and police and fire departments, but it did not do much to improve the economy (Boyer 2010). Economic decline continued for the next few decades, at the same time relationships between diverse groups within the community were being challenged by programs to promote in-migration to the U.S. Virgin Islands.

Ethnic relationships on St. Thomas reflect patterns established during the colonial period. The subsequent economic development plans and the role of the U.S. federal government did little to improve lives in the USVI. Boyer (2010), Grace-McCaskey (2012), Johnston (1987, 1994, 1998) each highlight the trajectory resulting in the frustration and marginalization of segments of the local society. Lamarsh Roopnarine (2010) argues that despite the diverse and complex ethnic groups and some amount of mixing, the U.S. Virgin Islands is characterized by defined groups of people that include Black Virgin Islanders, Eastern Caribbean Islanders, Puerto Ricans, Spanish Dominicans, French Islander, Americans (Continentals), Arabs, and

Asians (791). There is a distinction between native islanders, or those who are able to trace their heritage back to the earlier colonial period, those who migrated from surrounding island nations to fulfill much needed labor shortages, and those from the continental U.S. (Grace-McCaskey 2012, de Albuquerque 1995). Migrations intensified during the tourism development phase in the 1960s.

The progression from early colonial plantation economic systems to economic downturn, continued economic downturn after the United States purchased the territory, and subsequent tourism development highlights the political, economic, and ecological trajectory that produced the current ethnic relations on St. Thomas. The U.S. Census data from the year 2000 (Table 1) show a total U.S. Virgin Islands population of 108,612, with 53,234 on St. Croix, 4,197 on St. John, and 51,181 on St. Thomas. The St. Thomas ethnic breakdown was as follows:

Table 1. St. Thomas Census (2000) Ethnicity, Race and Ancestry Count

Ethnicity	**Count**
White	6,456
Black/African American	41,286
American Indian/Alaska	101
Asian	717
Native Hawaiian/Pacific	9
Some other "race"	1,235
Mexican	106
Puerto Rican	1,160
Cuban	48

The current ethnic make-up reflects a long history of colonial enterprises and the later United States economic development practices, but these numbers do little to elucidate the current political demarcations resulting from a long history of foreign economic development in the Virgin Islands. Johnston (1998) notes that "although St. Thomas's political structure is

dominated by black native Virgin Islanders (in terms of both elected officials and government employment), the economy is largely controlled by white residents. Native Virgin Islanders (people whose families date back to the pre-1917 era of Danish control) are now a minority" (287). These distinct groups within the community each pursue political interests and maintain strong group identity (de Albuquerque et al.1985; Grace-McCaskey 2012). The distinctions are tied to their legal status as citizens of the U.S. Puerto Ricans have managed to gain more political presence due to their pre-existing status as U.S. citizens. Native Virgin Islanders account for slightly less than half of the U.S. Virgin Island population, with a mostly black demographic, but including a small number of white descendants from the plantation period (Grace-McCaskey 2012). There is an underlying resentment towards white Continentals and other outsiders, mostly because of the contention related to what constitutes a native islander. Throughout the years, Virgin Island citizenship has been tied to factors that at one point pre-dated the U.S. purchase. Later periods defined citizenship with the individual having at least one parent born in the U.S. Virgin Islands, and most recently it is granted to those who are U.S. born or a naturalized citizen (Boyer 2010; Grace-McCaskey 2012; Johnston 1994, 1998). These local relationships are based on, and reflected by, the broader political relationship between the Virgin Islands and the United States.

Politically, as a United States territory, the U.S. Virgin Islands' power and authority are derived from its relationship with the United States, but that relationship imposes limitations on the islands' self-determination. Leary (1988) points out that "as is so often the case when one deals with the politics and status of the Virgin Islands, it is best to begin by examining the outside forces that shaped events. As a small, vulnerable and dependent community, The Virgin Islands' destiny has frequently been determined by larger entities that have little interest in the

opinions of its population (59). As such, the U.S. Virgin Islands is situated politically between the United States and the rest of the Caribbean.

Historian William Boyer describes the 2009-2010 events surrounding the U.S. Virgin Islands draft constitution being presented at the U.S. Congress, and notes that the proposed constitution would allow for similar rights as other U.S. states:

> Notwithstanding financial and economic benefits gained by Virgin Islanders during almost a century of federal suzerainty, their struggle to enjoy a full measure of self-government is still not over. The so-called territorial clause of the United States Constitution...has been used to justify Congressional and executive action predicated on the assumptions of absolute federal discretion...As long as this unilateral authority exists, the Virgin Islands cannot be considered self-governing by the United Nations...the basic principles governing the federal-state relationship-namely, equality of treatment and limitation of federal power-are not extended to the territories. (2010:429)

This means that the federal-state relationship enjoyed by the rest of the United States, that affords some measure of control over agencies like FEMA and the EPA through congressional voting representation, is a luxury the U.S. Virgin Islands does not have. The above proposed constitution did not ultimately pass congress, and takes its position on a shelf with many other failed attempts in 1964, 1972, 1979, and 1993 either due to insufficient votes from U.S. Virgin Island public or failure to be passed through congress. It was suggested the local residents who did not support independence were intimidated by the challenges facing their neighbor Caribbean island nations who struggled after independence (Boyer 2010). As well, there was limited support from groups who saw more benefit from federal oversight, which provides assistance from federal social programs and supported economic development. The U.S. congress saw more benefit in keeping the U.S. Virgin Islands on the lowest rung of the colonial ladder, along with Guam, for its own purposes (Boyer 2010).

The U.S. Virgin Islands continues to be an exploited territory for the benefit of the U.S. federal government. Anecdotal information gleaned from conversations with local utility administrators who recounted their discussions with the director of the Department of the Interior (the department that oversees the U.S. territories) suggested that the Federal government is increasingly finding the territories to be a burden at the administrative level. An associated aspect of this political dynamic is how economic development occurs in relation to resource management and disaster vulnerability.

B.R. Johnston (1994) notes that resource use and abuse over the past 500 years contributed to the current state of the island's bankrupt ecology. Due to agriculture and tourism development the local ecology has experienced deforestation, soil loss, sedimentation of coral reef systems, and disruption of the hydrological system in the form of salt-water intrusion. Little has changed since the 1990s in regards to the impacts of resource use and abuse in the U.S.V.I, with tourism still the predominant and driving economic force contributing to negative ecological impacts. Prior to Hurricanes Irma and Maria in 2017, the islands would get over 2 million tourists visiting each year, with the tourist industry accounting for millions of dollars and many of the local jobs (VIBER 2015). The industry contributed $510 million in 2014 to the U.S. Virgin Island GDP (World Travel and Tourism Council 2015). The pre-hurricane 2016 GDP estimates showed an increase in visitor and local spending, and in petroleum and crude oil transactions (re-opening of the Limetree Bay Terminals, LLC oil storage facility on St. Croix), but the hurricanes cut off economic growth and the Territory shifted financial resources to recovery and building resilience. The loss of tourist accommodations, and water and energy infrastructures produced understandably low growth with the construction industry the only one being sustained. The economic outlook for 2019-2020 is for post-disaster tourism numbers to be

maintained until more hotels and accommodations come on-line. It is expected more construction jobs will be added (VIBER 2018:3).

Disasters in the United States Virgin Islands

For some multi-generational people in the US Virgin Islands, uncertainty is closely tied to their religious faith. For those living on the islands, the fourth Monday in July is the day to pray to be spared from hurricanes (Hurricane Supplication Day), while Thanksgiving in November is the day to give thanks for being spared from them. This is indicative of the long history of disaster events engraved in both the topography and human minds.

The territory has a long history of experiencing disruption and vulnerability to disaster events from natural hazards. Written records show that noticeable earthquakes occurred in 1785, 1824, 1844, 1865, 1867, 1913, 1959, 1962, 1970 and 1996. Tsunamis occurred less frequently with the earliest recorded on St. Thomas in 1690 (Watlington and Lincoln 1997; Watlington et al. 2014). One of the earliest recordings of disasters related to a natural hazard in the U.S. Virgin Islands is the combination earthquake and tsunami in November of 1867 (NHC& NOAA Website, accessed September 27, 2018; Watlington and Lincoln 1997). The earthquake, tsunami and a hurricane (a month earlier), caused wide-spread damage to the islands, and disrupted to the on-going negotiations between the United States and Denmark for purchase of the Virgin Islands. A disruption that was not resolved until 1917. The 1867 earthquake was the strongest and most impactful to strike the U.S. Virgin Island in recorded history, despite the islands experiencing frequent tremors since that event. The VITEMA Emergency Operations Plan states that “over the next two hundred years, as many as 170 individual events were recorded but none have been of great consequence since 1867” (2016:6).

For a Caribbean island hurricanes and tropical storms are a frequent natural hazard. Storms that originate in the Atlantic between June 1 and November 30 all have the potential to become high level hurricanes that can move through the region, leaving massive destruction in their wake. Hurricanes strong enough to cause severe damage that required long-term recovery efforts include Hurricane Hugo which was a Category 5 on the Saffir-Simpson Hurricane chart (Catastrophic Damage, Winds: Greater than 156 mph) that struck St. Croix (September 1989), Hurricane Marilyn (September 1995) was a very strong hurricane that passed over St. Thomas causing 10 deaths, $44 million in damages and was the most often discussed hurricane when I was asking local residents about disaster impacts on St. Thomas. In November 1999 Hurricane Lenny made landfall on St. Croix, and October 2008 Hurricane Omar also struck St. Croix. The next major hurricanes were the back-to-back events of Irma and Maria in September 2017, the impacts are still being felt and the recovery stage remains a challenge.

FEMA's Policies & Their Impacts

The disastrous 2017 hurricane season put FEMA to the test, and as of spring of 2018 when I returned to the territory, it continued to pose challenges for the Agency. Prior to Hurricanes Irma and Maria, most Virgin Island residents that recall the 1990s mostly associate their knowledge of FEMA with Hurricane Marilyn that struck in 1995. Post-Marilyn FEMA was a different organization with an altered approach to disaster vulnerability and recovery.

FEMA originated in 1979 through an Executive Order by President Jimmy Carter. The agency was created to address insufficient disaster responses prior to 1978. Early on, FEMA was headed by political appointees with no disaster management experience. Consequently, the agency's disaster management of Hurricane Hugo that struck The U.S. Virgin Islands, Puerto Rico, and southern Florida in 1992, revealed problems in how it responded to disasters. In 1993

President Bill Clinton appointed James Witt, an experienced emergency manager, therefore the Federal response to the recovery period post-Hurricane Marilyn is recalled by local people as a time of extensive support from the Federal Government. This "Golden Age of FEMA" (Sadiq et al. 2016) lasted until 2002 when the Homeland Security Act was passed. The new Act resulted in FEMA being subsumed, along with 21 other agencies, under Homeland Security. Instead of FEMA's Director reporting directly to the President, they reported to the Secretary of the Department of Homeland Security, adding an additional bureaucratic level to FEMA's operations and resulting in less priority of disaster related programs, because Homeland Security is focused on combating terrorist activities.

FEMA is mobilized through a specific process that begins with a state's governor declaring a state of emergency at the local level. If the state is unable to cope with the disaster it can request assistance from the federal government, which derives authority provided by the U.S. Disaster Relief Act of 1947 (amended by the Stafford Disaster Relief and Emergency Assistance Act of 1988). These Acts give the President the authority to decide if the crises exceed the state's coping capacities and whether a formal disaster declaration is required. Once the formal declaration has been issued, federal assistance is released and FEMA is activated in the disaster impacted area. The activation of FEMA allows the agency to act as administrator of federal government programs that includes providing temporary housing, cash grants to people who are not able to access other aid sources, and funds to restore public properties and facilities. It acts as a clearinghouse for assistance programs operated by the federal government, such as connecting local businesses with the Small Business Administration that administers loans for small businesses. It is important to note that FEMA's funding sources rely heavily on the local state's resources with the state being "the grantee for federal funds. The state or territory is held

accountable for their use, and FEMA determines how much local governments must contribute to offset the non-federal share. In turn, local governments not only help finance these efforts, but they must also help guide their implementation" (Schneider 1990). For example, the disaster mitigation project in post-Hurricane Marilyn began on St. Thomas in 1997 and was mandated to build the BtN and improve the watershed drainage. The project relied on funds from both the federal and the local government sources, with the Army Corps of Engineers providing some of the funds but the local government was expected to fund half of the total (Morris 2016).

Historical Trajectory of Water, Wastewater, and Energy Development on St. Thomas

Barbara Rose Johnston's work during the 1980s explored the intersections between tourism development and environmental degradation from a political ecology perspective on St. Thomas, USVI. Her dissertation sought to expand the investigation of tourism from an economic perspective to include indirect and less quantifiable impacts of development. Of consideration were the development impacts on social, economic and the environment that a political ecology approach highlights. This work investigated resource conflicts and how they were exacerbated by tourism development prior to the mid-1980s. In this case, the work explored the conflict between local fishers and resort development along the coast of St. Thomas. Ultimately, Johnston (1987) argues that the development process should be investigated from a political ecology framework in order to demonstrate "the value and importance of considering the cultural variables which influence political economic power relationships" (vii). My research adopts this approach by examining the political economic relationships among (waste) water, energy, and disaster management as it relates to local sustainable watershed development.

Johnston's (1994, 1998, 2005, 2012) later work related to political ecology on St. Thomas considers further the issues of power, development, and water. With a focus on water scarcity,

this research describes the socio-cultural processes that create water scarcity. Johnston (2012) describes water scarcity as "a state of immediate or impending crisis resulting from supply of water inadequate to meet the varied demands of humans and their environment" (265). Furthermore, water scarcity is relative to who declares it scarce, and the political, economic, and resource management policies related to water. This work provides an important foundation for my research and offers a critical evaluation of the local context, but how has the context changed since this important early work? Furthermore, how does current work consider similar aspects of wastewater and political ecology, and what might be missing in this contemporary work?

Investigating water, and other resource, scarcity provides a mechanism for revealing manifestations of local political ecologies. As noted in Chapter Two, political ecology provides a way to move away from understanding water and wastewater in a purely technological way, but incorporates social, economic, political, environmental and historical aspects in the exploration as a way to produce more sustainable community development. Scarcity does not simply refer to the amount of available resources, but who has access to them and in what way (Johnston 2012: xiii). In other words, scarcity is not distributed evenly and appears different in different locations (Whiteford and Vindrola Padros 2011).

The decline of sugar cane production throughout the U.S. Virgin Islands prior to the 1950s created an economic void that was soon filled by intensive tourist economic development, spurred on in the 1960s by the closure of Cuba to vacationing Americans (Boyer 2010; Dookhan 1994; Grace-McCaskey 2012; Johnston 1994). At this same time less emphasis was assigned to agriculture and light manufacturing, creating greater reliance on one economic sector. Tourism facilitated social change, including population increases, changes in cultural and ethnic

composition, created a native Virgin Islander minority, as well as altering how people make a living.

Energy Challenges & Sources

At the time of this research, the U.S. Virgin Islands were beginning a transition from energy needs met through strictly petroleum-based sources to renewable and more affordable sources for consumers. After the closing of the Hovensa oil refinery on St. Croix in 2012, the islands no longer had access to a reliable, affordable energy source for both electricity and water desalination. Consumers regularly paid 50 cents per kilowatt-hour for their electricity needs, five times higher than the U.S. average consumer (International Energy Information Administration 2015).

Moreover, residents experienced many electricity service interruptions, as a small snapshot of the notices posted on the VIWAPA website show:

- 17 Dec 2015 - Service Interruption to Small Section of St. Thomas Feeder 7B;
- 13 Dec 2015 - Service Interruption - Portion of St. Thomas 9D;
- 11 Dec 2015 - Service Interruption - Small Section of St. Thomas Feeder 9B;
- 27 Nov 2015 - Service Interruption - to Portion of St. Thomas Feeder 7D).

This prompted the local government to develop plans to reduce the territory's reliance on fossil fuels, and they set a goal of a 60% reduction by the year 2025. VIWAPA embarked on electricity generating station conversion to propane. As well, solar projects on both St. Thomas and St. Croix went online in 2015, and a proposed LNG pipeline to run from Puerto Rico to the U.S. Virgin Islands. These projects were accomplished as a pilot project of the International Energy Development in Island Nations (EDIN) program, a partnership between Iceland, New Zealand, and the United States that formed in 2008. These current issues did not simply appear within the

last few years, with no connection to larger global processes. The current wastewater, energy, and hazard vulnerabilities are a result of historical and ongoing processes tied to particular global-local power dynamics.

Water

The U.S. Virgin Islands Department of Natural Resources created a Safe Drinking Water Act (SDWA) in 1978 as mandated by federal U.S. policy. The SDWA was based on federal policies but it did not include the conditions specific to water supply in the Virgin Islands. Therefore, DNR monitored only certain sections of the public water supply system. As "noncommunity water systems", schools, hospitals, day-care centers, Head Start centers, restaurants, hotels, guest houses, shopping centers, transient marinas, campgrounds, and other very small systems serving transient consumers, were not monitored (Johnston 1998). Decentralized, privatized water systems (cisterns, bottled water, industrial, commercial, agricultural) were not being monitored either, leading to contamination of one of the larger water wellfields, the Tutu Wellfield. Additionally, there was testing for certain contaminants in community water systems but not others. In 1978 elements such as total coliform bacteria and measures of turbidity were conducted, while, radionuclides and organic chemicals were not tested for. They were assumed to only affect the continental United States, and were assumed to not be an issue in the U.S. Virgin Islands because it has so few above ground water sources.

The Tutu Wellfield was contaminated throughout the 1980s and 1990s from local businesses and industry. Cancer causing chemicals seeped into the island’s main subsurface aquifer and was only detected in 1996, causing an already water stressed public to demand answers. The subsequent lawsuits were settled by Esso Corporation, while the EPA and the U.S. Virgin Islands government were attempting to recover the clean-up costs, estimated at $15

million. Johnston (1998) argues that it is not simply a case of poor water monitoring, greed and the lack of government desire to publicly recognize the destruction, but that this event is tied to a larger process of development, alienation, and dependence. This watershed region also flows into the "gut" that drains water beneath the BtN and into the Mangrove Lagoon.

Centralized Wastewater Treatment

Sewerage on St. Thomas comes in two forms, a centralized wastewater treatment system operated by the Virgin Islands Waste Management Authority (VIWMA), with five treatment facility locations capable of handling various sewage capacities. The Airport Treatment Facility, serves a population of 19, 531, collects 2.6 Mgd (Millions of Gallons per Day), and has a capacity 3.5 Mgd. The Mangrove Lagoon Treatment Facility, serves a population of 13,363, collects 0.93 Mgd has a present capacity of 1.1 Mgd, and can handle the greatest capacity. The remaining three facilities serve a population of one thousand or less. The total St. Thomas sewage treatment facility capacity was 5.07 Mgd and was collecting 3.61 Mgd. To serve all island households would require a capacity of 6.31 Mgd (Cadmus Group, Inc. 2011). Those not connected to the centralized treatment facilities rely on onsite sewage disposal systems (OSDS). The Cadmus Group, Inc. (2011) report produced on behalf of the EPA, presents their findings from an evaluation of conventional OSDS systems compared with alternative wastewater treatment processes.

Decentralized Wastewater Treatment on St. Thomas

The Cadmus Group (2011) research finds that much of St. Thomas is not suitable for conventional OSDS systems that rely on specific soil compositions. They found that due to the requirement of these systems for a specific amount of space to effectively remove harmful elements from sewage, they were not effective in alleviating the deposit of harmful elements into

the surface, ground water and coastal watershed. They recommend incorporating alternative OSDS, and found a constructed wetland to be the most effective OSDS for St. Thomas households.

The constructed wetland that is recommended by the Cadmus Group (2011) can be used under diverse set of site conditions. They require a 3-chambered septic tank to allow for sufficient separation of solids. The effluent is then typically distributed to a number of sequential wetland 'cells' that are constructed of concrete and an impervious liner. The wetland cells contain gravel and dirt, along with wetland vegetation. Both the substrate and the vegetation provide treatment to the wastewater" (Cadmus Group, Ltd. 2011:15). This report was produced in response to the EPAs request for the U.S. Virgin Islands to improve water quality in order to meet the Federal Clean Water Act (CWA), and outlines water quality issues such as contamination of surface water from:

- Failure to properly install effective site control devices during construction,
- Failure to contain storm water run-off from unpaved roads,
- Failure of on-site disposal systems (OSDS).

Pollution of ground water from:

- Bacteriological contamination from failing septic systems,
- Leaking municipal sewer lines
- Migration of contamination from previous injections and disposal practices
- Frequent sewage bypasses (generally described as discharges direct to the sea, but with percolation into sub-soils)

It appears these issues continue to be a problem, as noted in the Virgin Island's DPNR U.S. Virgin Island Integrated Water Quality: Monitoring & Assessment Report (2014) which

continues to outline water quality issues due to those noted above. Aging sewage and septic systems combine with poor practices and financial issues in producing poor water quality, contributing to the loss of EPA funding for USVI. Of interest to my research is the EPA's finding of an insufficient wastewater system. In the event of a storm, the system is overwhelmed, leading to bypass and overflows, as well as water quality problems (EPA OIG Audit 2015:15). Johnston (1998) describes how the disconnect between EPA regulations and the local Caribbean island context manifested into catastrophe.

In the USVI resource decisions are typically made with the tourist industry primarily in mind, and are based on the continental U.S. values related to economic investment, political interest, conservation and ethics. All of which directly influence how resources are managed. The resident's experience of alienation from their environment through a loss of subsistence-based lifestyle translated into less control and access to natural resources. Johnston (1998) concedes that the transition improved some aspects of standards of living, but she finds that less interaction with the natural environment reduced an interest and knowledge about the environment. Since the time of Johnston's (1998) writing, political ecology scholarship has shown that complete "alienation" may be lacking a nuanced understanding of water, agency, and human-environment relations. In the above discussion, water is the backdrop on which economics and politics are perpetuated, but can we bring this exploration into the current political ecology understanding of water, by asking how water in the local St. Thomas context has shaped emergent outcomes with regard to local water policy?

Johnston (1994) identifies a shift in policy towards resource management and re-acquaintance of local residents to their environment through both conservation projects and education. An environmental education specialist was hired with public funds to work with

public schools and provide summer training. Likewise, fisheries regulations since 1987 have begun to incorporate a co-management structure through a council comprised of self-elected fishers and chaired by the nonvoting Director of Fish and Wildlife. The council meets regularly to discuss the fishery Biologists' concerns with reef fisheries health. But, as Grace-McCaskey (2012) argues, these meetings are often contentions and complicated by diverse perspectives and needs, and contain few mechanisms to bridge the gaps. These water resource issues seem to be less relevant to residents today on St. Thomas as compared to the energy crises.

The relationship between water scarcity, sewerage infrastructure and natural hazards is highlighted in Johnston's description of the impacts on St. Thomas of Hurricane's Hugo (1989), Luis and Marilyn (1995) and Bertha (1996). Prior to the storms, cisterns had intermittently been replenished by private water delivery trucks (Figure 7) outside the WAPA service area (mostly those living outside Charlotte Amalie). After the hurricanes, the delivery industry increased substantially. She notes:

> Hurricane Luis loosened up the island's structures, and a week later Hurricane Marilyn tore roofs, rain gutters, and catchment systems from 85 percent of the buildings. Ten months later, Hurricane Bertha tore away the blue FEMA tarps covering many roofs, pulled apart newly replaced roofs, and ripped away many of the remaining rain gutters. As a result, water delivery companies now provide much of, and in many cases all, the water for household consumption in rural areas (1998:301)

Figure 7. Water Delivery Truck (Photo Credit: Maya Trotz, July 2018)

It became even more apparent to residents how important water and energy was as a resource, since water is tied to energy through the desalination plants in the U.S. Virgin Islands and cisterns require electric pumps to move the water to the household. After Hurricane Marilyn WAPA was shut down for six weeks. Combined with downed power poles and other infrastructure issues, it meant some did not have power for more than three months. Moreover, this storm produced increased water production, storage, and distribution system contamination. Sewage plants were off-line, resulting in pollution of coastal waters and marine inflow pipe contamination (Johnston 1998). These impacts contributed to a series of water and energy disasters that were not only tied to local infrastructures, but were a result of a history of economic development based on tourism and manufacturing that created a state of "alienation" (Johnston 1994) of local residents from their environment.

Chapter Summary

This chapter provides a grounding for my research in St. Thomas, and seeks to situate this study in the local geographical, historical, political and economic setting, by highlighting the global-local dynamics shaping water, energy, wastewater infrastructures and disaster planning on

the island. I began with a geographic description of the location and landscape of the U.S. Virgin Islands and St. Thomas to establish the physical aspects of being a Caribbean island. This moved to a brief outline of the multiple historical periods to provide insight into the diverse population we have today on St. Thomas. The next section outlines the historical and contemporary disasters that have impacted the territory, that includes a deeper look at the role of FEMA. Finally, this chapter concludes with an overview of the development of water, energy, and wastewater infrastructures on St. Thomas. In the next chapter I present my methodology, including the research design I employed, my sampling strategy, the approach to analysis, the ethics that guided the research, and the limitations and challenges I encountered while conducting this research.

CHAPTER FOUR: METHODS

Chapter Overview

My dissertation field research began with a preliminary 10-day visit in May of 2015. The bulk of the data was collected during my time living on St. Thomas between February 2016 and August 2016, with brief return trips in November 2016, January 2017, and March 2018 for approximately one to two weeks long. This chapter describes my choice of St. Thomas as a field site, outlines the methods used during my field research to gather data related to answering my research questions, and their purpose. As well, this chapter explains my sampling rationale and provides background on the research participants. I explain the analysis approach and the ethics that guided the research. Finally, I discuss the potential limitations and challenges of using these methods. The first section explores the role of field research in anthropology and explains how ethnographic methods can be used to answer questions related to (waste) water and energy infrastructures and disasters.

Methodology

I selected the United States Virgin Islands as a field site in part due to my desire to explore disaster anthropology research in the Caribbean and because my university department advisor's involvement with the USF NSF PIRE project. The PIRE project is a cross-disciplinary and multi-sited research project involving environmental engineers, applied anthropologists, and marine biologists from the University of South Florida and the University of the Virgin Islands. The overarching goal of the PIRE project was to investigate local wastewater, water, and energy challenges with the desire to determine location appropriate solutions, while also looking at why

and how people make decisions related to new technology and their perception of reclaiming water, energy, and nutrients from wastewater. The applied anthropology portion of the project incorporates field research methods that involve the researcher spending six months to a year at the field site to gather “culturally sensitive” data related to water, wastewater, energy and disaster perceptions. In my research, this was ethnographically grounded through observation, interviews, and surveys.

The field research on St. Thomas entailed engaging with residents, representatives with the Water and Power Authority and Waste Management Authority, Department of Planning and Natural Resources, Virgin Islands Emergency Management Agency, students and professors with the University of the Virgin Islands, representatives with non-profit conservation organizations, Virgin Islands Senators, business owners, and a church congregation. Data collected with these participants was gathered through participant observation, informal conversations, semi-structured interviews (n=15), surveys (n=43), a focus group (n=10) and one participatory mapping activity (n=4). My time there permitted me to inquire about "social roles, motivations, conceptual assumptions and cultural logics” (Alley 2006: 450) and how they “need to be understood in terms of how they shape institutions and provide legitimacy, and in terms of political economies operating across local, regional, national, and international fields" (Alley 2006:450). Ethnographic fieldwork concerned with the St. Thomas (waste) water, energy, and disaster infrastructures allowed me to incorporate the social, conceptual assumptions and cultural logics into an understanding of how local institutions dedicated to these elements are shaped and are legitimated at multiple scales (Bernard 2011; Cairns 2014).

Kim Fortun (2008) describes the anthropological ethnographic approach as:

> Ethnography…provides a powerful and efficient way to read historical conditions. It produces both situated and comparative insight, is able to see across scale, and leverage different analytic lenses. It can draw out nested and proximate systems, sensitive to their similarities, differences, and synergisms. (451)

Ethnography allows for research questions to be investigated across scale and analytic lenses, making it useful for exploring the similarities, differences, synergies between how knowledge is authorized in relation to wastewater, energy and disaster vulnerability. Ethnography often involves a mixture of methods; archival research, participant observation, interviews, and surveys (Bernard 2011; Schensul and LeCompte 2011; DeWalt and Dewalt 2002).

The ethnographic approach to understanding the local socio-cultural setting requires engagement with the St. Thomas community to understand its processes, structures, practices, norms and beliefs. It allows for the inclusion of the overall cultural context surrounding the U.S. Virgin Island (waste) water sustainable development, disaster vulnerability and resilience (LeCompte and Schensul 2013; Schensul 2009). Ethnographic methods incorporate firsthand experiences and accounts that are revealed through recording the research participant's perspectives and activities. To gather data useful to exploring (waste) water, energy infrastructure and disaster vulnerability, required the use of methods designed to discover patterns and themes related to local U.S. Virgin Islands (waste) water, energy and disaster perceptions.

Research methods, such as surveys, semi-structured interviews, participant observation, and participatory mapping permitted me to explore the local utility infrastructures context. They provided me a clearer understanding of how (waste) water and energy utility infrastructures were developed on St. Thomas and the political ecology of those infrastructures. These methods

informed an understanding of the cultural models that define how these infrastructures were perceived locally, by seeing and experiencing first-hand how stakeholders live with and understand them.

Participant Observation

My primary data collection method was participant observation, which involves spending enough physical time with people to make them feel comfortable enough to allow the researcher to observe and record (Bernard 2011; DeWalt and DeWalt 2002). Similar to Cairn's (2014) work, my focus on wastewater involves uncovering the intricate relationship people have with wastewater and energy. Within my research focus I add disaster vulnerability and the politics embedded in how water and energy are treated by the community. Participant observation allows the researcher to integrate themselves into the society that can present opportunities to engage with people in their day-to-day lives. Integration can permit the researcher to gain an understanding of the cultural meanings attributed to the aspects of the culture that the researcher is interested in learning about. In the case of my research it is the cultural meanings of water, energy and disaster.

Informal and Semi-Structured Interviews

Closely related to participant observation are informal and semi-structured interviews. Informal interviews are not structured, but rely on a more casual conversation format and can happen in any location. Bernard (2011) suggests that informal interviews can be useful in the early stages of fieldwork to assist the researcher in settling in. Throughout the research process, these conversational interviews can be useful in rapport building and reveal further topics for investigation. Semi-structured interviews are generally scripted, but are open-ended, meaning the informants are guided but have the opportunity to talk about the topic in their own way. Semi-structured interviews should have formal written guides to ensure reliable qualitative data, and

are useful when interviewing individuals who are used to efficient use of their time, such as high-level bureaucrats and other elite members of the community. This shows that the interviewee is competent and they have a measure of control over the interview, at the same time not suggesting excessive control, as it permits the interview process to follow new leads (Bernard 2011).

Semi-structured interviews were used to elicit data concerned with the disaster management, wastewater and energy infrastructures on St. Thomas. These interviews were done with government officials and other stakeholders that held official positions in the community. For my research, semi-structured interview guides were designed with purposive sampling. This work is concerned specifically with interrogating the (waste) water, energy and disaster management; semi-structured interview guides were created to elicit information from individuals in the community who attend to the operations and development of these infrastructures and disaster management programs.

Surveys

Surveys were the most structured method I utilized to collect quantitative data. The surveys were based on the existing one developed by the Belize PIRE project, participant observation, and the informal and semi-structured interviews. Building on the Belize PIRE survey instrument allowed me to produce a survey that efficiently and quickly gathered data relevant to specific themes uncovered throughout the research process (Bernard 2011). Similar to Wells et al. (2014) and Cairns (2014), surveys were administered with smart phone enabled KoBo, an open-access platform. The 10-minute survey was administered both in paper handout form and digitally, and utilized KoBo, an open-access application installed on a smartphone that

is designed to assist with administration of surveys and analysis of the data collected through the application.

The survey was designed to specifically address my H1 and H3, that state that perceptions of risk and vulnerability are complex political ecological events that are connected with infrastructures to broader historical, political, and social processes. Therefore, the survey variables included gender, occupation, island tenure, age, ethnicity, level of risk perception on a Likert scale regarding wastewater/energy/coastal resources, knowledge about water/energy utility/coastal resource/disaster planning, whether the respondent took part in disaster planning processes, and their understanding of the degree of community inclusion in planning process on a Likert scale. The KoBo survey questionnaire is attached as Appendix A.

Focus Group & Participatory Mapping

Focus group interviews, although challenging to organize and coordinate, have the potential to produce a large amount of data in a smaller time-frame and involve a greater number of participants than interviews allow for. Focus groups are useful in gathering information on cultural domains and opinions on a topic of a group of people (Schensul and LeCompte 2013).

The focus group activity revealed how residents conceptualize and utilize their water, wastewater, and energy systems (Schensul and LeCompte 2013:112; Whiteford et al. 2015; Wells et al. 2014). Furthermore, the activity highlighted how participant's thought about risk to hazards such as tsunami and coastal erosion, and showed collective behavior surrounding the topics we explored (Wells et al. 2014). The insight gained from the group mapping activity (Figure 8) informed the coastal health and livelihoods component of this research, by revealing the participant's perceptions related to (waste) water and energy disaster risks.

Figure 8. Participatory Map Made with Focus Group and Erasable Markers (Photo Credit: Cori Bender August 2016)

Participants were given erasable markers and asked questions about what they thought was vulnerable in their community, whether they thought the wastewater, water and energy infrastructures were vulnerable, whether they thought they could recover from a disaster, and their knowledge of VITEMA.

Research Design

The first phase of the study consisted of a site visit in May 2015 for 10 days to determine its feasibility for a water-energy nexus and disaster vulnerability study. I evaluated feasibility by conducting an interview with the Director of the Virgin Islands Emergency Management Agency (not the same individual who was running the Agency during my remaining field research activities), in person discussions with my University of the Virgin Islands Committee Member, Dr. Marilyn Brandt with the Marine and Environmental Sciences department, and informal conversations with community business owners and residents.

I returned to St. Thomas February 2016 to begin the next phase of the study that required me to live on the island for six months to collect data relevant to my research questions. This phase involved collecting data through a survey, semi-structured interviews, participant observation, archives and literature searches, and a focus group and participatory mapping

activity. I describe and discuss these methods further in the later section concerned with each of the methods I used.

I made three return trips to St. Thomas, in November 2016 for one week, in January 2017 for four days, and March 2018 for one week. The November trip allowed me to participate in a portion of the Smith Bay Watershed project assessment and evaluation activities. A project conducted by Horsley Whitten Group, an environmental engineering and design firm based in the eastern mainland United States, and the Virgin Islands Department of Planning and Natural Resources. I describe this project and its relevance to this study in more detail in the discussion chapter, but it should be noted here that the Smith Bay Watershed project gave me the opportunity to observe how watershed flood mitigation assessment and planning was done on St. Thomas through a public-private partnership, and was directly associated with one of the watershed regions I focused my data collection in, the east end. This week-long trip also involved interviews with two representatives of the Virgin Islands Energy Department and further archival research at the local public library.

The January 2017 return trip was as part of the USF PIRE team that was invited for the Emefcy MABR wastewater treatment plant inauguration in the west end community of Bordeaux. The new wastewater treatment facility was a joint project through the Virgin Islands Waste Management Authority and an Israeli environmental engineering business, Emefcy. The project was focused on retrofitting an existing inefficient wastewater treatment system to incorporate a modular design that used less energy to treat wastewater. The USF and UVI PIRE team members were invited because of the connections between the USF environmental engineering department and Emefcy MABR. During this trip I was able to observe the outcome of this new wastewater treatment facility in the Bordeaux region that replaced a previous

sequential batch reactor with an extended aeration system, built in 1969, and that produced high energy costs for the VI Waste Management Authority (VIWMA). As noted previously, energy production in the USVI is very costly, approximately three times the average that those on the mainland United States pay. Therefore, the local government made it a priority to reduce its reliance on petroleum-based energy, with a goal of a 60% reduction by the year 2025. With those goals in mind, the local government agencies and authorities responsible for the utility infrastructures were looking into ways to reduce energy use, and this project filled that need.

Finally, the March 2018 trip to St. Thomas was organized with Dr. Marilyn Brandt and was an opportunity to present my research at the UVI in a seminar format. During this trip I arranged to conduct follow-up interviews with my VITEMA contact and one of the local resident participants who contributed to my data collection in 2016. This trip allowed me to follow-up with observations and some preliminary data results that were emerging from the data analysis. As well, I was able to tour the island to observe the post hurricane disaster environment, highlighting how the Island was entrenched in the Building Back Better phase.

Research Questions

Data collection methods were selected to address my research questions. My questions are presented in the introductory chapter, but I include them here for reference purposes:

1. What is the current structure of (waste) water and energy utilities, coastal resource management, and disaster planning on St. Thomas, USVI, and how can the policies related to infrastructures work for the local context, given global-local dynamics influencing the policy process?
2. How do the local USVI government agencies understand “risk” and “vulnerability”, and how is their understanding similar/different to how other institutions and social science

assess them? How does that translate into policies concerning water, energy, and disaster infrastructures?

3. What is the relationship between authoritative knowledge and local knowledge in disaster mitigation planning and coastal resource management on St. Thomas, USVI?

Table 2 summarizes each of the research questions, what data collection methods were used and the types of data collected to address the research questions.

Table 2. Research Questions and Data Collection Methods

Research Question	Method	Data Collected
What is the current structure of (waste) water and energy utilities, coastal resource management, and disaster planning on St. Thomas, USVI, and how can the policies related to infrastructures work for the local context, given global-local dynamics influencing the policy process?	Participant Observation; literature and archives review, survey data, informal and semi-structured interviews	• Historical and current (waste) water, energy utilities, coastal resource management and disaster planning structures and policies • Procedures for policy development in the U.S.V.I. • How global forces shape local policies and how they influence local disaster vulnerability • Perceptions related to (waste) water, energy, coastal resources, and disaster planning
How do the local USVI government agencies understand "risk" and "vulnerability"? How does that translate into policies concerning water, energy, and disaster infrastructures?	Participant Observation, literature and archives, informal and semi-structured interviews	• USVI government approach to risk and vulnerability assessment • How the government approach to risk and vulnerability informs (waste) water, energy, coastal resource, and disaster policies
What is the relationship between authoritative knowledge and local knowledge in disaster mitigation planning and coastal resource management on St. Thomas, USVI?	Participant Observation; literature and archives review, survey data, informal and semi-structured interviews, focus group and participatory mapping	• Participant's perceptions of (waste) water, energy, coastal resources and disaster in their community • Degree of integration of local knowledge in disaster mitigation planning and coastal resource management • Local cultural models of (waste) water, energy, coastal resources and disaster vulnerability

Sampling Strategy

Research Assistant

I was assisted with survey administration by Logan Williams, a Master's student with the UVI Marine and Environmental Sciences department. Logan's assistance was funded through Dr. Marilyn Brandt's EPSCoR funding. As someone who grew up on the northside of St. Thomas and is white, Logan was able to facilitate greater access to survey participants on the northside of the island, and with the Moravian church choir through her former high school French teacher.

Semi-structured Interviews

The interview guides were designed with purposive sampling. Because I looked specifically at wastewater, energy, coastal resource and disaster management, semi-structured interview guides were created to elicit information from individuals in the community who attended to or were involved in these areas. The semi-structured script that guided the interviews with participants is attached as Appendix B.

I conducted purposive interviews with participants (pseudonyms are used to protect participant's identities) from Virgin Islands Emergency Management, Department of Planning & Natural Resources, Water & Power Authority, the local Police Force, the USVI Senate, local business owners and residents. Total number of semi-structured interviews were fifteen (n=15). Interviewees are listed in Table 3 below:

Table 3. Interviewees Sampling

Interviewees	Relation to Research Questions
2 Smith Bay Barbers (small business owners)	H3: interviewees provided their LK perspective of disaster vulnerability, water, energy & wastewater as local residents and small business owners. This informs whether there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management.
2 VITEMA Employees	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.
2 USVI Energy Department Employees	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.
2 Small Business Owners (One a produce stand and the other commercial businesses)	H3: interviewees provided their LK perspective of disaster vulnerability, water, energy & wastewater as local residents and small business owners. This informs whether there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management.
1 DPNR Employee	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.
1 Smith Bay Police Officer	H3: interviewees provided their LK perspective of disaster vulnerability, water, energy & wastewater as local residents and small business owners. This informs whether there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management.
1 VIWMA Employee	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.
1 Non-Profit Conservation Society Member/Small Business Owner	H3: interviewees provided their LK perspective of disaster vulnerability, water, energy & wastewater as local residents and small business owners. This informs whether there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management.
1 Coral Bay Employee/Non-Profit Blue Flag Beach Quality Evaluator	H3: interviewees provided their LK perspective of disaster vulnerability, water, energy & wastewater as local residents and small business owners. This informs whether there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management.
1 USVI Senator	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.
1WAPA Junior Engineer	H1, H2 & H3: these interviewees gave the AK perspective related to how the VI emergency management agency understands disaster vulnerability.

The semi-structured interview participants consisted of both men (n=11) and women (n=4), those born in the USVI (n=11), those arriving as adults (n=4), small business owners (n=5), government employees/representatives (n=9), one employed by the tourism industry (n=1), and two individuals working with non-profit conservation organizations (n=2). I chose these participants to take part in the semi-structured interviews because they either represented government agencies and could provide an AK perspective, or they could offer insight into community vulnerability and coastal resource health. I contacted two high level WAPA

representatives to arrange interviews. They received permission from the interim director to take part in an interview, but they did not respond to my emails asking them when they would like to meet. I also attempted to arrange an interview with the owner of a local eco-tour business, but she was off island and not able to meet with me in person.

Interviewees determined where the interviews took place and were mostly where they worked, the business they owned, or we met at a location they were comfortable with. Data gathered through semi-structured interviews inform each of my hypotheses by eliciting information related to local utility infrastructures, risk perceptions, and what constitutes LK and AK regarding (waste) water, energy, the environment and disaster vulnerability.

Surveys

Survey respondents were randomly selected but were specific to a particular watershed region on St. Thomas. Selecting a specific watershed region, rather than attempting to sample from the entire island, allowed for a narrower focus on potential differences in risk and vulnerability perceptions. To get a representative sample of the selected watershed regions, surveys were administered on different days of the week and at different times of day. The survey was given to randomly selected residents within each watershed region and totaled 43 individuals, that included a Moravian church congregation (Figure 9). My Moravian church contact, Logan William, recommended a paper version of the survey for the older members of the congregation because they tended to be less comfortable with digital technology. The paper permitted people to take surveys home with them, which has the drawback of people not completing them and turning them back in, but did offer some flexibility for those who were not

able to stay after the church service to complete a survey with me. Of the twenty paper surveys handed out I received ten back.

Figure 9. Moravian Church Members Attending Public Memorial Day Event (Photo credit: Cori Bender 2016)

Additional survey participant selection criteria were based on scheduling two to four hours of walking through the locations listed in Table 4.

Table 4. Description of Survey Locations & Respondents

Red Hook (East End)	Participants were contacted through the service industry, e.g. scuba dive shop, beach apparel store, boat supply store, were predominantly those employed in the service industry and identified as white.
Tillet Gardens (East End – Central)	Participants were contacted through the service industry, were either small shop owners or employees, and were both white and African-Caribbean.
Moravian Church (East End)	The church congregation consisted of mostly African-Caribbean and Hispanic people from the community.
Horse Race Track (East End – South side)	Participants were African-Caribbean people who frequent the race track.
Hull Bay (Northside)	These participants predominantly live on the northside of the island and trace their heritage through the Frenchie community, some of which are local fisherman. I utilized Hull Bay Hideaway, a bar/restaurant, as a convenient location to contact people who live on the northside, and were all white.
Tutu (East End)	This is the heavy commercial and shopping area that contains the Zellers store and Plaza Extra grocery store, and is the only shopping mall on island. Survey participants were both white and African-Caribbean.
Coki Beach (East End)	Small business owner/operator of a food hut, and was African-Caribbean.

Surveys were conducted with residents, but for convenience purposes, I focused on those living/working on the east end and Northside of the island. Some demographic differences between these regions include socioeconomic and cultural identity. Many of the northside residents trace their heritage back to earlier colonial French inhabitants and are known locally as the "Frenchies" and identify as white or Caucasian. While the east end, although having a mixture of people, is predominantly those who identify as West Indian or Black, some multigenerational but also some from other Caribbean islands who arrived as adults. Figure 10 is a map of St. Thomas with each survey location indicated, as well as my home and the university locations.

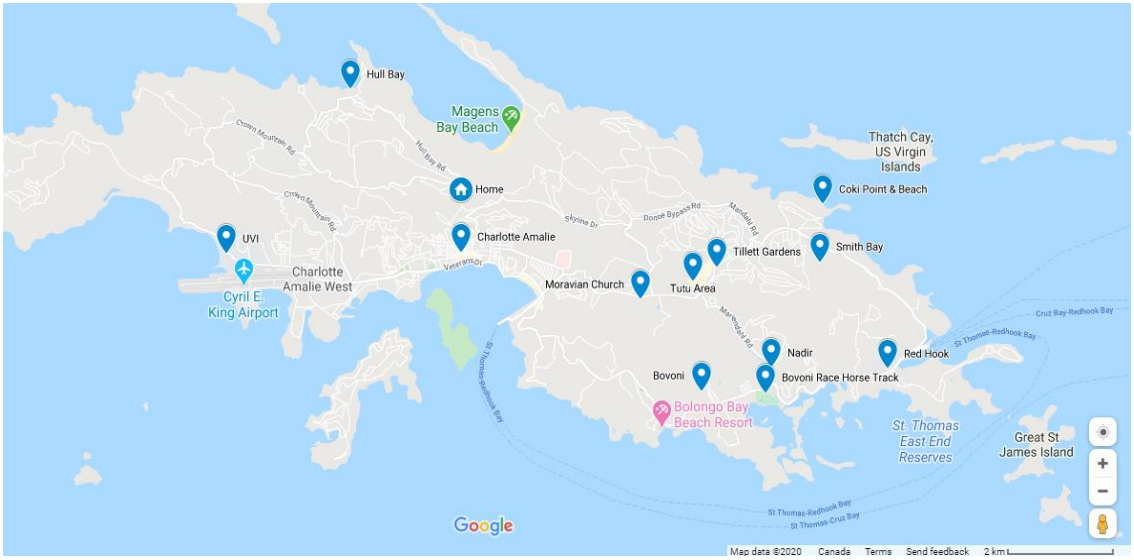

Figure 10. Map Showing Survey Data Collection Locations on St. Thomas

Demographics

The survey respondents' demographics include the following factors: Area of Residence, Years of Residence, Gender, Age, Ancestry, Education, Monthly Income, and Occupation. This section presents the results of the surveys based on demographic categories. First, I discuss each of the categories beginning with their relation to Area of Residence.

As noted previously, my goal was to focus on the East End of St. Thomas, but due to convenience sampling and access to survey participants, I found it necessary to include residents from other parts of the island, many from the northside of St. Thomas. Shown below is the breakdown of what part of the island the respondents are from. Regions are based on how local community members identify them, and are based on the East End that includes the areas of Smith Bay, Bovoni, and the Country. It has a high population with many residents and tourist establishments. Of the 42 respondents, 24 (57%) were from the East End, 13 (31%) resided on the Northside of the island, 4 (10%) were more centrally located near Charlotte Amalie (also referred to as "Town"), and 1 (2%) person was located on the southern part of the island not far from the airport (Figure 10). It is important to determine the number of years of residence as it is relevant when investigating disaster perceptions and knowledge in relation to LK. Table 5 shows the breakdown based on Years of Residence. Years of Residence (n=42) are categorized by 1-5 Years and totaled 7 (16%), by 6-15 Years that totalled 10 (24%), and by 16 & Over Years with 25 (60%). These results are important to my later discussion in Chapter 6 related to investigating the AK perceptions that new people are more interested in learning about what they need to do to prepare for disaster versus how long-term residents think about disaster preparation.

Table 5. Area of Residence & Years of Residence Demographics

Demographic	Profile	Frequency	Percentage
Area of Residence	East	24	57%
	North	13	31%
	Central	4	10%
	South	1	2%
Years of Residence			
	1 - 5 years	7	16%
	6 - 15 years	10	24%
	16 & over years	25	60%

Respondents only identified as women or men (n=42). Table 6 below shows women totaled 24 (57%) and men were 18 (43%). The Age (n=42) categories are set as ranges 18-35 Years totalling 14 (33%), 36-45 Years was 7 (17%), 46-55 Years totaled 6 (14%), 56-65 Years was 5 (12%), 66-75 Years totaled 6 (14%), and 76 & Over Years totaled 4 (10%). Education (n=42) categories include Graduate Degree/Professional with 14 (33%), Some University totaled 12 (29%), High School was 11 (26%), Some High School was 4 (10%), and Primary School was 1 (2%). Ancestry (n=37) was categorized as African-Caribbean totaling 12 (32%) and Other totaling 25 (68%). The respondent's occupations (n=40) included Management, Business, Sciences & Arts with 14 (35%), Service Industry totalled 13 (33%), Sales & Office with 2 (5%), Natural Resources, Construction & Maintenance of 5 (13%), and Retired totalling 6 (15%). Monthly income (n=39) categories were $0-1000 USD and totalled 6 (15%), $1000-2000 USD was 9 (23%), $2000-3000 USD was 7 (18%), $3000 USD or more totalled 9 (24%), and Prefer Not to Answer was 8 (21%).

The survey demographic data is representative of the broader U.S. Virgin Islands demographics for gender, the age ranges between ages 35 and 65, but the remaining categories do not closely align with the overall demographic statistics from the 2010 Census. The six-year span between the census data and when I collected data, and my small sample size, may contribute to the difference in my respondents' demographics and the census information. As well, the fact that I am white and my research assistant was white limited our access to the African-Caribbean perspectives in the community.

Table 6. Gender, Age, Education, Ancestry, Occupation, & Monthly Income Demographics

Demographic	Profile	Frequency	Percentage	USVI Census (2010)
Gender	Female	24	57%	52%
	Male	18	43%	48%
Age (years)	18 - 35	14	33%	17%
	36 - 45	7	17%	13%
	46 - 55	6	14%	15%
	56 - 65	5	12%	14%
	66 - 75	6	14%	9%
	76 & Over	4	10%	5%
Education	Graduate/Professional Degree	14	33%	7%
	Some University	12	29%	15%
	High School	11	26%	31%
	Some High School	4	10%	15%
	Primary	1	2%	16%
Ancestry	African-Caribbean	12	32%	No Census Data
	Other	25	68%	No Census Data
Occupation	Mngmt, Business, Sciences & Arts	14	35%	27%
	Service Industry	13	33%	25%
	Sales & Office	2	5%	25%
	Natural Res., Const. & Maint.	5	13%	13%
	Retired	6	15%	No Census Data
Monthly Income (USD)	$0 - 1000	6	15%	No Census Data
	$1000 - 2000	9	23%	No Census Data
	$2000 - 3000	7	18%	No Census Data
	$3000 of more	9	23%	No Census Data
	Prefer Not to Answer	8	21%	No Census Data

Literature Review, Archives & Social Media

My data collection began with an extensive review of the existing literature while still in Florida and continued throughout my field research period through library and archive searches on St. Thomas. The literature review done prior to leaving for St. Thomas involved searching the USF library, electronic academic journals, and other internet sources to locate academic work related to political ecology, anthropology of water, energy, wastewater, and infrastructures, as well as disaster vulnerability perceptions. I reached out via email to other researchers when I was unable to locate copies of their work related to St. Thomas, and was able to access those

publications on-line through academic archives. The literature review is supplemented with non-academic materials, such as governmental reports and internet websites. I continued to gather literature and information once I arrived on St. Thomas through the UVI library, the USVI Legislative archives, the St. Thomas Public Library, and social media such as Facebook. The special Caribbean collections at the new St. Thomas Regional Library was useful in filling in information gaps related to popular media.

A Facebook page titled "What's Going on St. Thomas" (WGOST) is a social media site where people interested in what is happening on St. Thomas or those buying or selling items, can submit posts or catch up on events. It is also a platform that people use to express their opinions about things concerning St. Thomas, such as government corruption, high incidences of gun shootings, WAPA's unreliability, and the weather. I would check the page daily for not only community events that I could take part in, but also for opinions and perceptions related to water, energy and local politics. I recorded items that were interesting by taking screenshots and saving them in digital format for further analysis along with field notes, interviews, photos and videos.

The literature review was the foundation for developing my research questions as well as contributing to my overall research design. The literature provided information related to the academic understanding of (waste) water, energy, and disaster vulnerability, while archives and the WGOST Facebook page gave insight into how people construct their understanding of the local (waste) water, energy, and disaster infrastructures.

Participant Observation and Informal Interviews

Table 7 summarizes the categories informed by types of observations and the objectives for each type of participant observation.

Table 7. Participant Observation Types & Objectives

Category	Types of Observations	Objective
Water, Wastewater, Energy, and Disaster Infrastructures	• Day-to-day observations • Tours of Emefcy Bordeaux and Veolia wastewater treatment facilities • Attended SBWP meetings and participated in their watershed flooding assessment • Attended the UVI Earth Day Event	• Learn what water, wastewater, energy, and disaster infrastructures exist on St. Thomas • Observe how water, wastewater, and energy facilities are managed and funded by taking part in events that brought together representatives from WAPA, WMA, and experts currently working to install a solar power array on the UVI campus
Water, Wastewater, Energy, and Coastal Resources Policy Development	• Attended recycling bill legislative hearings • Attended DPNR STEER meeting	• Observe how policy is created in the USVI • Learn what is prioritized and the types of knowledge that informs water, wastewater, energy and coastal resource policy
Local Knowledge and Authoritative Knowledge	• Day-to-day observations • Data collection trip with UVI MES graduate students and taking part in Dr. Marilyn Brant's Lab meetings • Attended the UVI EPSCoR Conference • Took part in the UVI Research Day (presented a research poster for my current research) • Attended VITEMA & Tropical Shipping Public-Private Disaster Seminar for local business owners	• Understand the relationship between Local Knowledge and Authoritative Knowledge in addressing coastal resource vulnerability • Learn how VITEMA understands disaster vulnerability and how it differs or is similar to how residents understand it
Building Rapport	• Day-to-day observations • Attended community events like the Saturday market, Carnival, and Moravian church services, • Visited key locations where people gather in the east end and north side of the island such as Tillett Gardens, the horse race track, Coki Beach, town of Red Hook, and Hull Bay	• Used as a method to get to know people in the community • Learn local cultural norms • Facilitate relationship building and participant recruitment and referral • Observe and take part in daily life on St. Thomas • Learn informally about people's water, wastewater, energy, and disaster perceptions

Table 7 summarizes the locations I conducted participant observation on St. Thomas. For the six-month field research period, along with three other shorter trips to the island, I took part in community events allowing me to engage with members of the community. I made four visits

to the Saturday market (Figure 11) in Charlotte Amalie (also known as “town”). Local merchants sell produce and products that they grow, make themselves or import from the local Caribbean region. While attending the Saturday Market I met a local produce vendor, whom I refer to as Mary. Mary was friendly and showed interest in my research and was very keen to speak about her experience of water and energy scarcity on the island. This led to Mary further assisting me by introducing me to other vendors in Tillet Gardens (a small commercial and entertainment location located in the central – eastern part of the island) who completed surveys with me (Figure 12).

Figure 11. Photo of Saturday Market Charlotte Amalie

Tillett Gardens (Figure 12) became an important location throughout my research. As both a commercial and social meeting place, the Gardens is well known by residents and is easy to get to as it is on the dollar safari route (an economical form of transportation mostly used by residents. Safaris are pickup trucks modified with bench seating and a canopy covering the bed of the truck where passengers sit side by side). Four interview participants met me at Tillett Gardens and six surveys were done with small business proprietors located in the Gardens. Vendors included a bar/restaurant, ice cream shop, hostel operator, gift/craft shop, tailor, produce stand, candle maker, baker, and an antique/collectors’ shop. The mixture of people who frequent

the Gardens meant I was able to observe and participate in social activities that facilitated informal, casual conversations with people about water, energy, wastewater and disaster.

Figure 12. Photo of Tillett Gardens Hostel & Shops in Tutu Area (East End)

Within a couple months of living on St. Thomas, I realized the importance of attending church, synagogue, or other religious congregations, to residents. I determined that a church would be a valuable location to engage in surveys, interviews and participant observation. Churches, and other activities centered around the church, created opportunities to interact with people and engage in conversation. I was introduced to a local Moravian church (Figure 13) by a UVI student I met during one of Dr. Brandt's summer lab meetings. This student was an undergraduate taking part in a marine biology summer program with the UVI, who grew up on St. Thomas. Discussions during one of the marine biology lab meetings led me to inquire with her as to whether it would be a good idea to attend some of the church events and Sunday services. She thought it would be fine, and it was just a matter of determining when and how best to introduce me to members of the Moravian church congregation. Church activities, such as the Memorial Day event and Sunday church services, were opportunities to participate and observe residents, as well as determine possible survey participants.

Figure 13. Photo of St. Thomas East End Moravian Church

In total I attended five Sunday services and the church's Memorial Day celebration. The church congregation was very welcoming, and I was not only able to conduct participant observation with them, but these events provided occasions to conduct a focus group with the church choir. For the second Sunday church service I attended, I was able to borrow a car from Dr. Brant, and was driving up the steep road to the church when I notice two elderly people get off of a safari bus and begin walking up the road. They were dressed in formal clothing, suit for the man and dress for the woman, and I assumed that they were walking up the hill to the church. I pulled over and asked if they would accept my offer of a ride to the church, which is the typical practice of local people on the island, and they were happy to accept. I appreciated the opportunity to have an informal conversation with members of the church congregation and found it was a great chance to introduce myself. This same Sunday visit to the church service also highlighted for me just how reliant and dependent we are as field researchers on the kindness of offered by members of the community we are engaging in the research process with. When I locked the keys in the car in the church parking lot, it was members of the congregation that helped me locate a locksmith willing to work on a Sunday afternoon. As researchers, we are certainly grateful and are thankful for a community's participation, but I am not certain we

convey enough just how much those living in the communities assist us with day-to-day functioning.

Church Choir Focus Group

The focus group Logan and I conducted with the Moravian church choir originated through Logan's contact with the choir director, her former French language instructor at her high school. We coordinated through email with the choir director to do the focus group one weekday evening after the choir practice at the Moravian church. Participants (n=10) were all members of the church choir and gave their permission of us to audio record the session.

The church was a quiet, private location to conduct a focus group, and my impression was that participants were at ease in participating in a focus group in a familiar location. I began the session by ascertaining informed consent by all participants, as per the IRB requirements. I informed the group that I could not completely guarantee their anonymity as it was dependent on the other participant's discretion, which cannot be guaranteed. Once we went through the informed consent, I proceeded with the description of the research project and how their participation would contribute to an understanding of water, energy, wastewater, the coastal environment, and disasters. Initially I hoped to utilize an enlarged map of St. Thomas as part of a participatory disaster mapping focus group, but due to mis-communication with Logan, we did not have the enlarged map with us. I determined it would still be beneficial to conduct a focus group, and we proceeded to work through the semi-structured interview script with the church choir. The participants were engaged and interested in discussing the challenges of disasters, such as hurricanes, and the local energy and (waste) water infrastructures. The transcription of this focus group forms part of the data that I aggregate with interviews and field notes for later analysis.

Participatory Mapping Activity

Due to challenges in coordinating people in the community for participatory mapping activities, I was only able to conduct one mapping activity in a pared down format. The activity was scheduled for a Sunday afternoon at Hull Bay Hideaway, a small bar/restaurant on the Northside of St. Thomas that is directly on Hull Bay. Most of the participants were contacted through Logan and were residents of the northside of the island (n=4). One participant was a construction worker in his 20s that Logan and I met at the Roti food bus on the Eastend of St. Thomas when we stopped for lunch one day. The other three participants were women, also in their 20s, and were friends of Logan's from high school. We arranged to meet the mapping activity participants by email and text message. Originally, more people said they would like to participate, but they did not make it that afternoon. It was a busy, hot Sunday with many social activities taking place on St. Thomas, potentially contributing to why more people were not able to participate. In fact, that day at Hull Bay, there was a spear fishing competition taking place that was drawing large crowds of spectators.

The social gathering lent the mapping activity an added aspect of relaxed atmosphere that possibly contributed to the easy flowing conversations and the participants' willingness to candidly describe their perceptions of disaster on St. Thomas. The large, laminated FEMA flood hazard map of St. Thomas was a great tool to elicit responses form participants. None of the community members were aware that FEMA had a flood hazards map of St. Thomas, or that there were even flood zones on the island. Despite the small participant sample, I understand why the incorporation of participatory mapping activities can assist in generating important data concerned with disaster risk and vulnerability. Giving participants a marker and map to interact

with produced responses that seemed more based on their interest in answering the questions than when I was just asking open-ended questions.

Analysis

The research methods I employed provided data that could be analyzed using different methods. This section is broken into the analysis procedures used for the qualitative data and then the methods applied to quantitative data analysis.

Field Notes, Semi-Structured Interviews & Grey Material (Qualitative Data)

Throughout the data collection process, I typed my observation and interview notes. Upon returning to Florida, I transcribed the audio interview recordings, with assistance from a fellow PIRE team member, Gabby Lehigh. Once the interviews were transcribed, I uploaded them to the qualitative analysis software along with field notes and focus group notes. Dedoose is a cross-platform application used to analyze qualitative and mixed methods research with text, photos, audio, and videos. It enables the researcher to closely analyze the data for themes by applying codes determined by the researcher. Codes and sub-codes emerged through an iterative process and were based on observed patterns and themes. This is a technique that aids the grounded theory approach (Glaser and Strauss 1967) and is used to organize data and assist the researcher in coding.

Surveys (Quantitative Data)

Survey responses were analyzed with SPSS and Excel. The results produced were in the form of descriptive statistics, frequencies, crosstabs, and non-parametric tests due to the small sample size and the resulting restrictions in generalizing data to the larger population (Schensul and LeCompte 2013). I used SPSS to conduct Pearson's Chi-Square analysis to determine significant relations between demographic variables and the perception questions based on what

I was seeing from the frequencies and crosstab analysis. I grouped the surveys based on geographic regions, with total surveys including East End, Northside, Central and Southside. As noted above, there were only four respondents from the Central area, and one from the South. Therefore, I did not conduct further significance testing on these survey results. The bulk of the respondents were from the East End and Northside, and so I proceeded to test for significance based on these two regions as well as the total, amalgamated group of surveys. Significance testing was applied to demographic profiles and perception questions and only those with $p < 0.05$ are included in the Results chapter.

Presentation of Results

In Chapter Five I present the results from my data analysis and have arranged it by each of my hypotheses. Within each hypothesis section, I provide the rationale for applying results from each of my data sources to that hypothesis, and detail the data results based on the methods described above. I combine the quantitative and qualitative data results in each section, that includes surveys, Dedoose results and Word Cloud results from my interviews, field notes, and focus group data. I further incorporate data analysis results in Chapter Six when I engage in a synergistic discussion of the results with the applicable theory from my literature review that includes excerpts from interviews and field notes that are relevant to each hypothesis.

Ethics

In addition to adhering to the protocol required for Institutional Review Board approval, I employed ethics standard practices based on the American Anthropological Associations ethics guidelines (AAA 2012) The AAA emphasizes doing no harm to research participants and the broader community, requires the informed consent of all participants, and that the researcher conduct research in an honest and transparent manner. The IRB Approval Letter is attached as

Appendix C. Furthermore, I identify competing ethical obligations, but place importance on obligations related to participants. I utilized a written and verbal informed consent process that described the research project and details potential risks. As well, I ensured participant anonymity, to safeguard the participant's identities (LeCompte and Schensul 2010; Whiteford and Trotter 2008).

It is important to consider the political positioning of multiple stakeholders when conducting research in a diverse community like St. Thomas. This project was conducted in close connection to the University of the Virgin Islands, with some contact with local government agencies, and considerable interaction with local residents. Due to the involvement of government agencies, it could be argued that the research could benefit those agencies over the local residents. Furthermore, there is a potential for any power differential between a government agency and local residents to be reinforced through this project. These potential conflicts have been addressed in the applied anthropology field in the past with work done with policy makers. Laura Nader's (1972) recommendation that the field would benefit from "studying up" and through the policy making institutions has inspired much anthropological research. Following this suggestion, my project explores the decision- making process related to wastewater, energy, and disaster vulnerability through working closely with not only the government agencies producing policies directed at managing these areas, but also by working with island residents to understand their perspectives. This understanding can inform policy decisions and potentially be a platform for resident's inclusion in the processes.

Limitations

As the research instrument (Schensul 2009), the researcher absorbs information and processes it into something tangible, but they tend to have little control over the information they

receive. Unlike surveys and structured interviews, participant observation lacks structure. The information the researcher receives can be in any form and content. Conversely, these challenges are offset by the opportunity to gain a greater understanding of cultural processes and phenomenon through direct experience, while interviews can address specific questions in order to compliment observed phenomenon.

Additionally, the local island environment proved challenging at times. Local community events, although important to gaining a holistic understanding of cultural models, were often very loud and kinetic with people enjoying food, music and each other's company, making it difficult to have conversations. Events like Carnival and Afternoon on the Green at the UVI, were great observation opportunities but they made communicating about my research difficult and therefore not conducive to doing surveys. Moravian church events were better for communicating to community members my research and purpose for being there as they tended to be more subdued and quieter.

As with many locations, gun violence was an issue and was a further constrain on my research activities. I typically did not venture out at night unless I was accompanied by someone familiar with St. Thomas neighborhoods and who had a car. Intermittent access to a vehicle that I could drive meant I was mostly reliant on the dollar safari buses or taxis for transportation. Transportation was not the only constraint, but as white women, my research assistant and I did not have access to all perspectives due to a long history of ethnic oppression by white colonial powers. This tended to restrict my movements throughout St. Thomas, but it also provided me a chance to get to know women like Mary, the Sunday market vendor, who seemed very comfortable chatting with me about her life and introducing me to other vendors. This work

captures the perspectives that were expressed to me at the time by people that were comfortable with sharing their time and opinions, but is not representative of all people living on St. Thomas.

My research protocol described my intent to incorporate participatory mapping, but while attempting to schedule this activity with the Moravian Church choir, I experienced logistical problems and a miscommunication resulted in a need to change the participatory mapping into a focus group without a mapping activity. I was still able to learn how this group of 10 individuals connected through their church choir and perceive disaster vulnerability in their community. I was not able to determine through collaborative mapping where they believe vulnerabilities are located specifically, but I gained insight into their overall understanding of vulnerability in their community and role of VITEMA.

The challenges regarding incorporating participatory elements into an applied research project include willingness of community members to take part in collaborative projects. Not necessarily because they do not identify with the project goals, but due to the constraints of daily living and distrust with authority structures, which is what I found in my research. The researcher should consider to what extent the participation is a full integration of the participant or whether they are using the exercise to gather information and use it without consideration of the power dynamics and culture models in the community. I was hesitant to fully develop the participatory mapping activity without having a concrete community partnership, and because of a high level of distrust between local residents and government agencies, I felt it was not feasible to fully utilize participatory mapping as a data gathering method.

Chapter Summary

In this chapter I explain my methodology and research design. It begins with a brief review of the role of ethnography in anthropology and why I use it as a research method when

exploring the water-energy nexus and disaster vulnerability. I then discuss my trips to St. Thomas beginning with my preliminary site visit in May 2015, continuing with my six-month long-term research, and finishing with three short trips in November 2016, January 2017, and March 2018. Next, the chapter outlines my research design, including data collection methods and analysis, with details about sampling and demographics. Finally, I discuss my ethical framework that I used when doing my research and finish by recognizing the limitations and challenges I experienced regarding my methodology. In the next chapter I begin to explore the results from my data analysis and develop synergy between my research results and what I have learned from the literature concerned with political ecology, (waste) water, energy and disaster vulnerability.

CHAPTER FIVE: RESULTS

Chapter Overview

This chapter presents the results of my data analysis and how it informs an understanding of the relationship between the U.S. Virgin Islands, the U.S. federal policies and the broader Caribbean community. As a cross-point between the U.S. federal level and the broader Caribbean context, the U.S. Virgin Islands is positioned to show the tensions of being a territory beholden to another nation-state. I arrange this chapter in three sections that explore each of my hypotheses in comparison with results from my data analysis. The first section (H1) looks at the challenges of being a Caribbean island at the cross-point between the U.S. Federal government and its various regulations, and the local context. The second section (H2) addresses data analysis results related to the perceptions of LK and AK holders regarding risk and disaster vulnerability, through the mechanism adopted by one Caribbean institution, two U.S. government agencies and VITEMA. The third section (H3) presents the data analysis related to disconnects between AK and LK within disaster planning and coastal resource management. Each hypothesis section begins with an explanation of the hypothesis, and for the H1 and H3 sections, I then discuss the survey variables where significant relationship were found. In the H2 section I provide the relevant results from each of the models and approaches that government and non-government institutions use to assess vulnerability related to disasters and climate change. This Chapter provides a foundation for further discussion of the data analysis in Chapter Six.

H1: The USVI at a Cross Point Between Federal Policies & Practices and the Local Context

Hypothesis 1 investigates how global-local dynamics influence policies and practices related to infrastructures for the local context of (waste) water and energy utilities, coastal resource management and disaster planning on St. Thomas. It assumes that the USVI is positioned geographically, physically and economically at a cross point between U.S. federal policies and regulations, and the broader Caribbean context, all of which fail to consider the uniquely local Caribbean challenges, such as access to funding and expertise needed to implement federal regulations.

The variables related to H1 are perceptions of the local (waste) water and energy infrastructures, coastal resources, and disaster planning. Local solutions to water and wastewater include both centralized and household level activities. As noted in Chapter Two, many homes on St. Thomas use septic systems to treat household sewage, and of the survey respondents (n=44) 46% had septic, 26% relied on the centralized waste management, 21% did not know what they used, and 7% indicated they utilized "other" means to treat their household sewage (usually alternative, closed loop systems on their property that involved utilizing grey water for watering plants and landscapes). Many residents access water through their cistern, with 71% said they relied on cistern/WAPA (meaning they had a cistern but also had access to the centralized water system through the water infrastructure), 14% said they would have the water trucks fill up their cisterns, and 7% were only utilizing WAPA as their water source. All the survey respondents were connected to the WAPA power grid and relied on the centralized power authority for their electricity.

To facilitate comparison, I present the survey data analysis results grouped in three categories; as the total combined surveys, those from participants that live in the East End, and

those living on the northside. As noted previously in the Settings chapter, the demographics tend to be different in each of these two areas and comparing them might show patterns of perceptions and activities related to those specific demographics and areas of the island.

I conducted initial crosstab analysis between each of the demographics and the survey perception questions to determine potential patterns in the survey participant's responses. The next step was to perform Pearson Chi-Square analysis on each of the demographics and perception questions. The results presented below are those that were significant with $p < 0.05$.

Water, Energy & Wastewater Perceptions (LK)

Statistical tests showed that the relation between years of residence and whether residents do things to conserve water and electricity were significant, X^2(df=2, n=41) = 7.11, p = 0.029.

Table 8. Cross Tab Analysis of Years of Residence with Household Water & Energy Conservation

Cross tab analysis of Years of Residence with "Does Your Household Do Things to Conserve Water & Electricty?"

Years of Residence	Yes (Frequency/ Percentage)	No (Frequency/ Percentage)
1-5 Years	7 (20%)	0
6-15 Years	6 (17%)	4 (67%)
16 & Over Years	22 (63%)	2 (33%)

X^2 = 7.11, p = 0.029

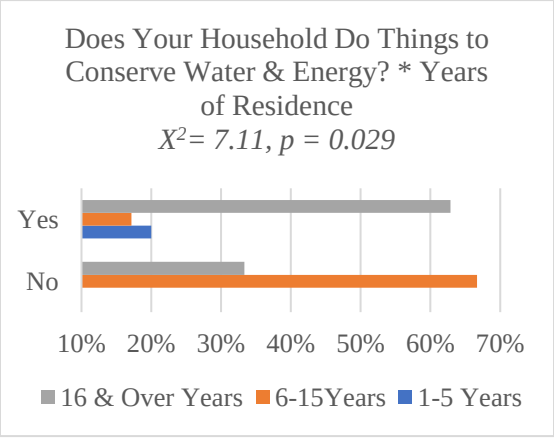

Figure 14. Graph of Household Water & Energy Conservation by Years of Residence

The crosstab results associated with the significance test conducted for the question "Does your household do things to conserve water and energy?" addresses the specifically local perceptions and activities directed at water and energy. How households think about, and the activities they perform, regarding these domains can highlight the unique local conditions and issues that people in the community live with daily. Some possible water and energy conservation household practices include not running the air conditioning unit to reduce electricity costs or reducing the time one spends in the shower. This question did not have a follow up question listing possible conservation practices for the respondents to select, but semi-structured interviews and participant observation further revealed how people addressed water and energy scarcity, elements I discuss further in Chapter Six.

The above Table 8 and Figure 14 show that the total survey respondents tend to take steps to conserve water and energy, and that those residing on the island for 16 years or more tended to adopt conservation activities, with 63% of the "Yes" responses occurring in this island tenure category. Of the six respondents who said "No" to conserving water and energy, none were new residents, and lived on St. Thomas for more than five years.

The relation between years of residence and whether residents from the east end of St. Thomas had issues with their electricity supplier is significant, X^2(df=2, n=22) = 7.70, p = 0.021. Years of residence and opinions about electricity supplier quality informs H1 by providing insight into how residents think about their electricity supplier, indicating where challenges exist. As I note in Chapter Two, the U.S. Virgin Islands experiences difficulties with consistent and affordable electricity, and the responses to this question reflect this.

Table 9. Cross Tab Analysis of East End Years of Residence with Whether There Have Been Electricity Supplier Issues

Cross tab analysis of Years of Residence with "Have You Had Issues with Your Electricity Supplier?" (East End)

Years of Residence	No (Frequency/ Percentage)	Yes (Frequency/ Percentage)
1 - 5 Years	0	3 (17%)
5 - 16 Years	3 (75%)	2 (11%)
16 & Over	1 (25%)	13 (72%)

$X^2 = 7.70, p = 0.021$

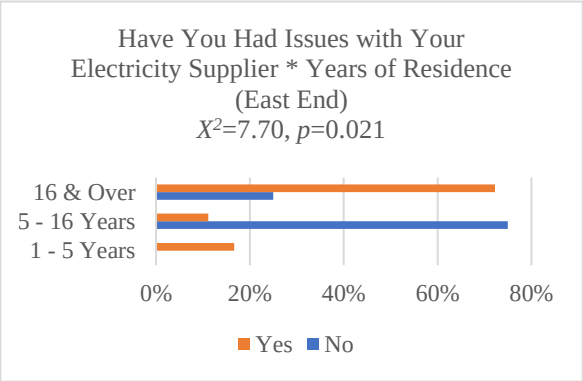

Figure 15. Graph of East End Perceptions of Electricity Supplier Quality by Years of Residence

Table 9 and Figure 15 show that most of the East End respondents have had issues with their electricity supplier, and of the "Yes" responses, 72% had lived on St. Thomas for more than 16 years. This significant result suggests that both island tenure and the fact that the respondents lived on the East End is important to how local people thought about their electricity supplier, which I explore further in my discussion chapter when considering the post-disaster environment.

The next significant results relate to the respondent's opinions about the renewable energy projects on St. Thomas and to what degree they agreed with the projects. The level of education for all of the survey responses and where they lived was significant. Living on the Northside did not appear to be a significant factor in how people answered this question. The

relation between education and all the survey respondent's agreement with renewable energy projects on St. Thomas was significant, X^2(df=16, n=41) = 27.63, p = 0.035 (Table 10 and Figure 16), and the relation between education and what those living on the east end of St. Thomas think about the local renewable energy projects was significant, X^2(df=16, n=24) = 30.25, p = 0.017 (Table 11 and Figure 17).

Table 10. Cross Tab Analysis of Education with Perceptions of Renewable Energy Projects

Cross tab analysis of Education with "What Do You Think of Renewable Energy Projects on St. Thomas?"

Education	Agree Strongly (Frequency/ Percentage)	Somewhat Agree (Frequency/ Percentage)	Neutral (Frequency/Percentage)	Not Sure I Agree (Frequency/ Percentage)	Disagree Strongly (Frequency/ Percentage)
Graduate/Professional	10 (71%)	2 (14%)	2 (14%)	0	0
Some University	10 (83%)	0	1 (8%)	0	1 (8%)
High School	7 (70%)	1 (10%)	1 (10%)	1 (10%)	0
Some High School	4 (100%)	0	0	0	0
Primary School	0	0	0	0	1 (100%)

X^2 = 27.63, p = 0.035

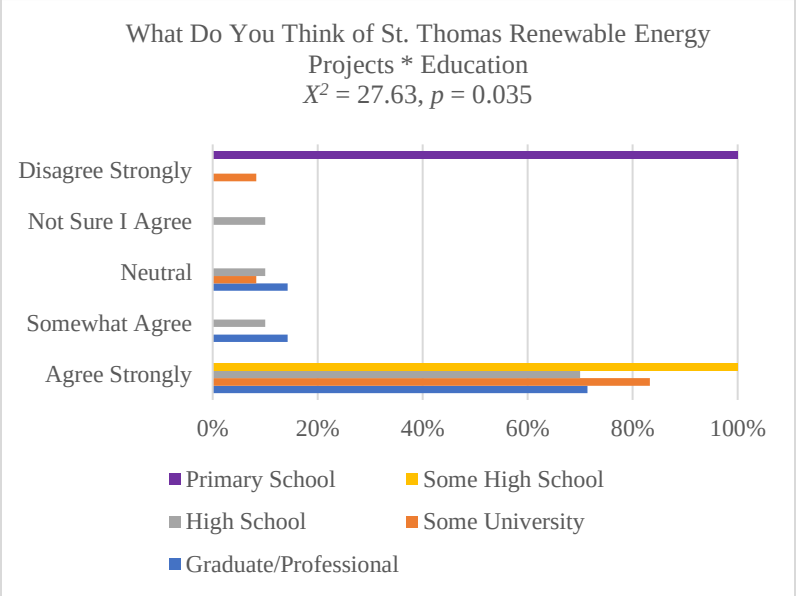

Figure 16. Graph of Perceptions of Renewable Energy Projects by Education

Table 11. Cross Tab Analysis of East End Education with Perceptions of Renewable Energy Projects

Cross tab analysis of Education with "What Do You Think of St. Thomas Renewable Energy Projects?" (East End)

Education	Agree Strongly (Frequency/ Percentage)	Somewhat Agree (Frequency/ Percentage)	Neutral (Frequency/ Percentage)	Not Sure I Agree (Frequency/ Percentage)	Disagree Strongly (Frequency/ Percentage)
Graduate/Professional	4 (25%)	2 (67%)	1 (33%)	0	0
Some University	2 (13%)	0	1 (33%)	0	0
Secondary/High School	6 (38%)	1 (33%)	1 (33%)	1 (100%)	0
Some Secondary/High School	4 (25%)	0	0	0	0
Primary	0	0	0	0	1 (100%)

$X^2 = 30.25, p = 0.017$

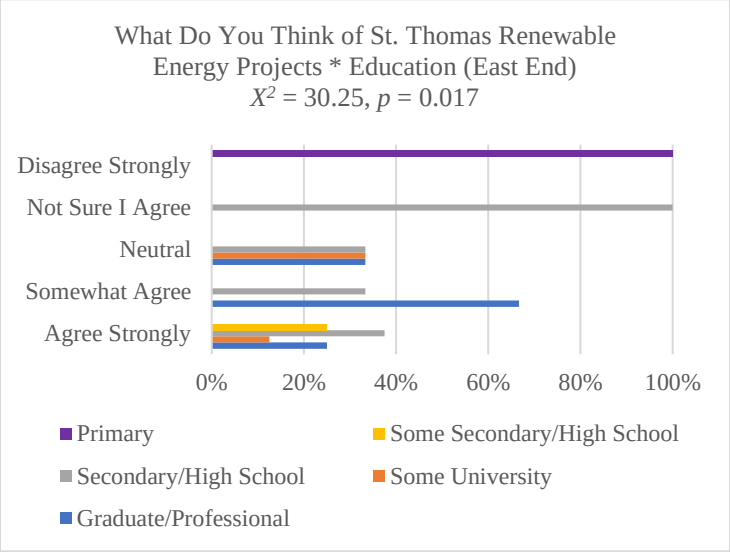

Figure 17. Graph of East End Perceptions of Renewable Energy Projects by Education

Many respondents indicated that they "Agree Strongly" with the renewable energy projects, with only the participant with a primary school education level for both groups, and one participant with some university from the total surveys, disagreeing strongly. These results suggest that education level and where a person lives on St. Thomas is possibly influencing how people think about renewable energy projects, factors that I investigate further in the next chapter when exploring the Building Back Better framework.

Like the questions related to energy, the proceeding questions concerned with water and wastewater inform H1 factors that assume the local Caribbean challenges associated with infrastructures are not addressed by the U.S. Federal government agencies. These survey questions show the uniqueness of being a Caribbean island and how simply getting safe drinking water and treated wastewater can potentially be an unreliable and complex process.

These questions were asking the respondent's opinions about their water supplier quality and results show that the relation between occupation and perceptions of water supplier quality were significant, X^2(df=16, N= 6) = 42.98, p = 0.000 for the total surveys (Table 12 and Figure 18).

Table 12. Cross Tab Analysis of Occupation with Perceptions of Water Supplier Quality

Cross tab analysis of Occupation with "What Do You Think of Your Water Supplier Quality?"

Occupation	Excellent (Frequency/ Percentage)	Very Good (Frequency/ Percentage)	Good (Frequency/ Percentage)	Poor (Frequency/ Percentage)	Very Poor (Frequency/ Percentage)
Mngmt, Business, Sciences & Arts	3 (38%)	4 (50%)	0	1 (13%)	0
Service Industry	3 (19%)	0	7 (44%)	6 (38%)	0
Sales & Office	0	0	1 (50%)	0	1 (50%)
Natural Resources, Construction & Maintenance	0	0	5 (100%)	0	0
Retired	0	2 (40%)	2 (40%)	1 (20%)	0

X^2 = 42.98, p = 0.000

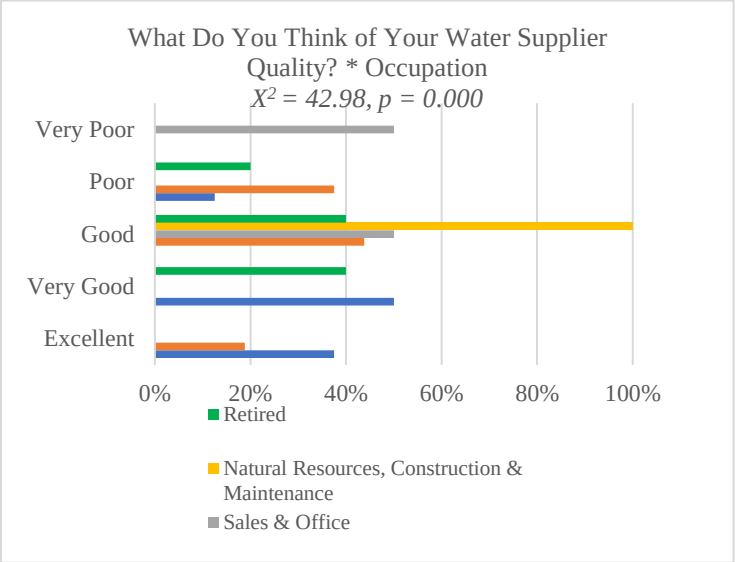

Figure 18. Graph of Perceptions of Water Supplier Quality by Occupation

Most respondents thought their water quality was "Good", with all of those working in the natural resources, construction and maintenance categories believing their water supplier was good. As I note in my chapter overview, 71% said they relied on cistern and WAPA for their water needs. Of all the respondents who were employed in the service industry those who thought their water supplier quality was poor were 38%, 44% thought it was good, and 19% thought it was excellent. Only one respondent said it was very poor and they were in the sales and office category.

The significant result was concerned with the relation between occupation and if the respondent living in the east end was concerned about water supplier quality, X^2(df=4, n=20) = 10.22, p = 0.037.

Table 13. Cross Tab Analysis of East End Occupation with Concerns About Water Supplier Quality

Cross tab analysis of Occupation with "Are You Concerned About the Water Supplier Quality?" (East End)

Occupation	No (Frequency/ Percentage)	Yes (Frequency/ Percentage)
Mgmt., Business, Science & Arts	6 (40%)	0
Service Industry	4 (27%)	2 (40%)
Sales & office	1 (7%)	1 (20%)
Natural Resources, Construction, & Maintenance	0	2 (40%)
Retired	4 (27%)	0

$X^2 = 10.22, p = 0.037$

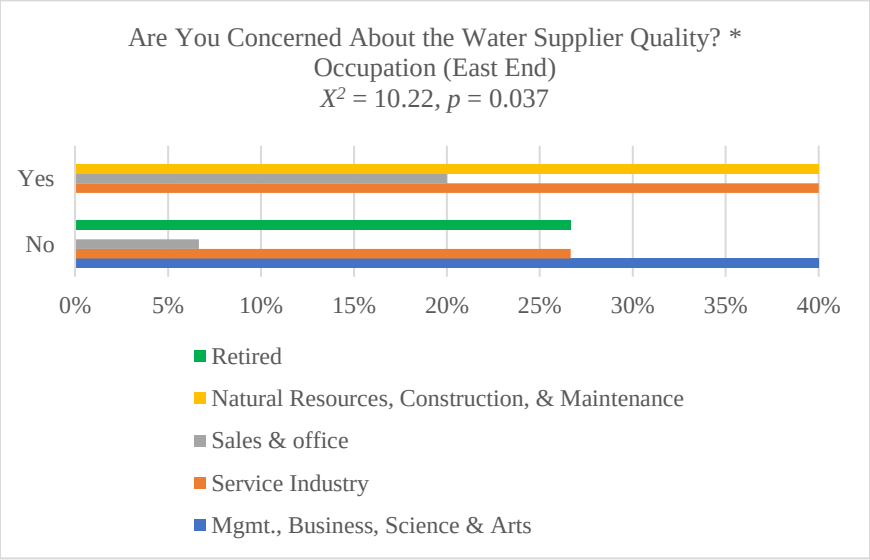

Figure 19. Graph of East End Concerns with Water Supplier Quality by Occupation

In response to the question asking if the person is *concerned* about their water supplier quality, similar to the results from the question asking the respondent's *perceptions* about their water supplier quality, those living on the East End answered more often that they were not concerned about water quality from their supplier (40%), and worked in the management, business, science and arts (Table 13 and Figure 19).

The relation between occupation and what residents living on the Northside perceived of their water supplier quality was also significant, X^2(df=6, n=12) = 15.43, p = 0.017, and like the total survey responses, this result shows that more participants responded that they believe their water supplier quality was “Good” to “Excellent” (Table 14 and Figure 20).

Table 14. Cross Tab Analysis of Northside Occupation with Perceptions of Water Supplier Quality

Cross tab analysis of Occupation with "What Do You Think of Your Water Supplier Quality?" (Northside)

Occupation	Excellent (Frequency/ Percentage)	Very Good (Frequency/ Percentage)	Good (Frequency/ Percentage)	Poor (Frequency/ Percentage)
Mngmt, Business, Science, & Arts	0	2 (100%)	0	0
Service Industry	1 (100%)	0	3 (50%)	3 (100%)
Natural Resources, Construction, & Maintenance	0	0	3 (50%)	0

X^2 = 15.43, p = 0.017

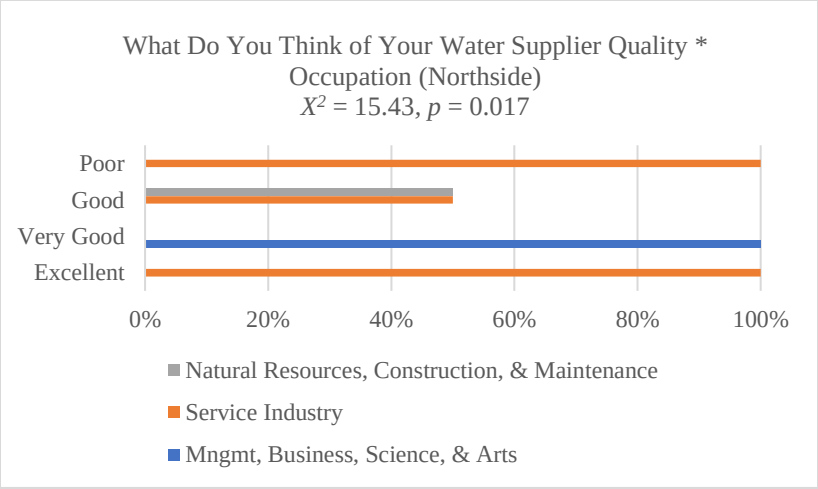

Figure 20. Graph of Northside Perceptions of Water Supplier Quality by Occupation

The above results suggest that overall people consider their water supplier to be safe, but that the industry a person works in might influence their perceptions about water quality. This was not anticipated, as most of the people I spoke with and spent time with, indicated they were concerned about the water supplied by WAPA, claiming the water they have coming from their

home taps is off-colour with rust due to the condition of the pipe infrastructure the water runs through to get to households.

The relation of years of residence and perceptions of how dangerous wastewater is for people's health was significant, X^2(df=4, n=42) = 10.47, p = 0.033. Analysis of the total surveys found that participants understand that wastewater can be "Somewhat" to "Very dangerous" to people's health.

Table 15. Cross Tab Analysis of Years of Residence with Perceptions of Wastewater Danger

Cross tab analysis of Years of Residence with "How Dangerous Do You Think Wastewater is to People?"

Years of Residence	Very Dangerous (Frequency/ Percentage)	Somewhat Dangerous (Frequency/Percentage)	I Don't Know (Frequency/ Percentage)
1-5 Years	6 (86%)	1 (14%)	0
6-15 Years	4 (40%)	5 (50%)	1 (10%)
16 & Over Years	22 (88%)	3 (12%)	0

X^2 = 10.47, p = 0.033

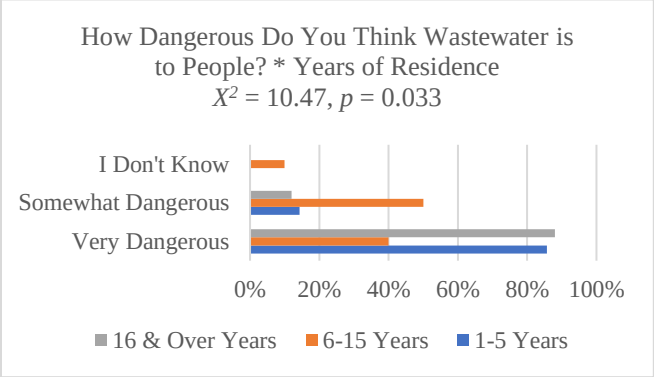

Figure 21. Graph of Perceptions of Wastewater Danger by Years of Residence

Residents with island tenure of 16 years and over responded more frequently that they thought wastewater can be dangerous to people (Table 15 and Figure 21). Potentially, those living on St. Thomas for a longer period have had more experience with the impacts of improperly treated wastewater, something I explore further in the discussion chapter.

H2: Risk and vulnerability: infrastructures are seen as disconnected from historical, political, and social processes resulting in a less resilient community

Hypothesis 2 compares how the U.S. Virgin Islands government understands disaster "risk" and "vulnerability" with how other institutions, agencies and the academic fields view them. This hypothesis assumes that, unlike the academic approach to understanding risk and vulnerability, the U.S. Virgin Island's government and associated agencies view risk and vulnerability as tied to geophysical and environmental hazards and not as political ecological events. Likewise, infrastructures are viewed as based on technology and science with limited influence from historical, political, and social processes.

The variables that inform Hypothesis 2 are water, energy and wastewater infrastructure, disaster risk, vulnerability, and mitigation approaches. I rely on descriptions of the tools and approaches utilized by the Caribbean Community (CARICOM) organization, FEMA, EPA, and VITEMA. This section begins with an outline of the models each organization adopts to understand and mitigate risk and vulnerability. I discuss whether the focus includes historical, political, and social processes. This section is a foundation for further investigation of these tools in the next chapter, where I utilize semi-structured interviewee responses from the participants associated with Virgin Islands Waste Management and VITEMA to provide further insight into how these agencies understand the above variables.

Caribbean Institutional Perspectives: CARICOM's CCORAL Tool

The Caribbean Climate Online Risk and Adaptation Tool (CCORAL) (Figure 22) is an example of a non-governmental institutional use of mechanisms designed to evaluate risks to the community from climate change and increasing disaster events. The Caribbean Community Climate Change Center (CCCCC) website offers a model for evaluating the procedures adopted

by Caribbean countries to determine if ongoing or new development projects are feasible when climate change and disaster are accounted for.

The CCORAL website does not include the USVI in its list of Caribbean countries that they support as part of their organization, suggesting that the island territory is considered a part of the United States, and not an autonomous, "developing" part of the broader Caribbean community. It should be noted that membership in CARICOM is open to Caribbean countries, but some countries do not have full membership, and are involved in activities as observers. They do not work as close with the institution on a formal level. Despite the USVI experiencing similar problems that other Caribbean island nations have related to climate change, such as sea level rise, more intense storms, and precipitation changes, they are not full members in CARICOM.

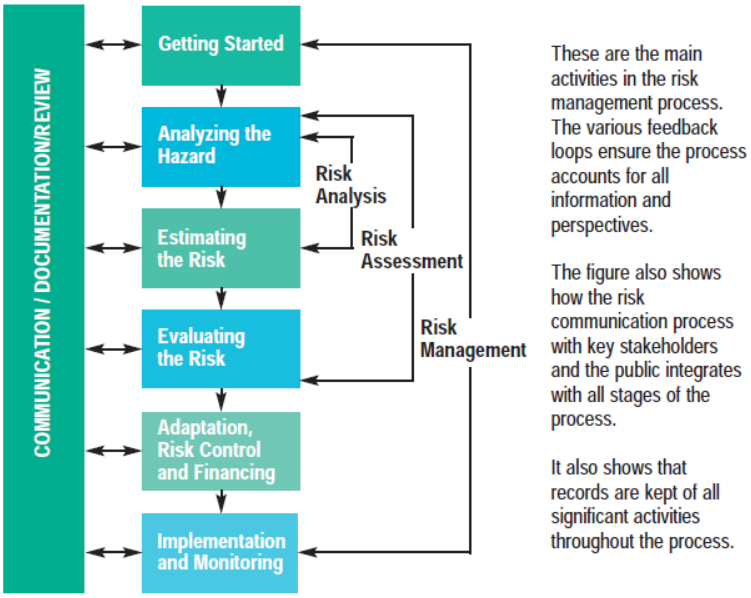

Figure 22. CARICOM CCORAL Steps in Risk Management Process (CARICOM 2003)

The CARICOM climate change risk assessment is based on a risk management process that offers some measure of precision to the decision-making process related to climate change adaptation, despite the challenges in predicting climate change outcomes and their impacts on communities. CCORAL adopts specific guiding principles that include, stakeholder involvement,

communication, promotion of sustainable development, maximization of the use of local expertise and knowledge, among others. This decision-making tool is geared to adaptation responses which can be addressed at the legislative level (e.g. building codes), infrastructure level (e.g. coastal protection), and behavioral level (e.g. water conservation, care of natural ecosystems). The authors recognize the challenge of convincing policy makers of the potential for climate change induced disaster and note that policy may stand a better chance of being changed if action is promoted within national sustainable development goals. Stakeholders include those affected by the decision-making risk management process, such as department of meteorology, national water authority, hotel association, among others.

FEMA & EPA Perspectives

The disjuncture between infrastructure development and risk and vulnerability is highlighted by the different approaches to risk analysis and how vulnerability is assessed. I selected three separate risk and vulnerability evaluation tools to explore the various ways risk is assessed institutionally. My selections were based on their direct relationship to my research questions, and include FEMA, EPA, and VITEMA. FEMA provides a risk assessment framework (Figure 23) that focuses on the threats themselves and less on the broader social-cultural context that result in vulnerability.

Figure 23. FEMA Threat and Hazard Identification and Risk Assessment (THIRA) (FEMA 2013)

FEMA's basic risk assessment model does not account for the broader social-cultural, and local and global processes that influence disaster outcomes. As noted previously, the political ecology framework provides a more nuanced understanding of risk and vulnerability that includes political, environmental, and social dynamics. The FEMA *Threat and Hazard Identification and Risk Assessment Guide* (2013), also known as the THIRA Process, outlines the steps necessary for communities to identify threats and hazards. The THIRA Process contains four steps, that includes as step one, identifying threats and hazards through a combination of experience, forecasting, expertise, and other resources. Step two is contextualizing the threats and hazards and how they may impact the community. Next the process recommends identifying capability targets in relation to the potential hazard or threat. Finally, application of results, which involves determining what resources are needed for each capability. Resources are identified as community assets, mutual aid, preparedness activities, and other mitigation opportunities. Vulnerability receives less concrete attention than risk in this process though.

Both FEMA and the EPA continue to evaluate risk perception as a technological and material exercise. The EPA ecological risk assessment tool used to evaluate a utilities hazard risk is referred to as Climate Resilience Evaluation and Awareness Tool (CREAT) (Figure 24).

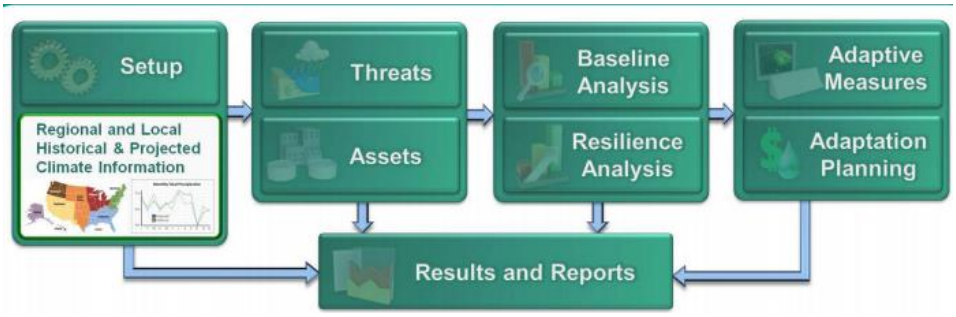

Figure 24. EPA CREAT Process: Application of climate information and utility knowledge to assess risks and challenges presented by climate change (EPA 2012)

CREAT is software designed to assist communities with evaluating water utility vulnerability to climate change. The software features climate change scenarios and pre-loaded wastewater and drinking water assets data. As well, the software draws on regional and local climate change data that includes threat assessment, climate change adaptation assessment and likelihood in reducing risks, and climate data and risk reduction reports. CREAT utilizes qualitative regional and quantitative local climate information that utilities operators can use to inform their planning process.

Each of the above risk assessment tools require some degree of inclusion of a variety of stakeholders, from government representatives to local organizations. Although not stated in the above chart, but indicated in the accompanying literature, the CCORAL tool appears to extend the evaluation framework to addressing human/social dynamics related to vulnerability. For the most part, these risk evaluation tools focus on technological and scientific approaches to understanding risk and vulnerability. The above institutional and government agency tools provide a starting point for evaluating disaster risk and vulnerability, but do not include information regarding implementation, vulnerability causation, as well as inclusion of the community member's lived experience of vulnerability and risk.

VITEMA Hazards and Capability Assessments

VITEMA approaches evaluating vulnerability from a demographic and hazard perspective. The 2016 Territorial Emergency Operations Plan (TEOP) describes disaster causing hazards as both man-made and natural. They include earthquakes, hurricanes/tropical storms, tsunamis, coastal and riverine flooding, infectious disease or other public health emergency, hazardous materials, and terrorism. VITEMA analyzes hazards by using historical information, assessing the relative frequency and possible severity of the event. It has recently expanded the

criteria for assessing hazards to infrastructure-based vulnerabilities. The TEOP notes that "Historically, the greatest risk is from natural hazards such as hurricanes, and earthquakes. However, the expansion of Water and Power Authority (WAPA) and the use of LPG, increase HAZMAT risk in the Territory" (2016:6). The development of liquid natural gas into the energy infrastructure poses new risks to the island community.

The VITEMA capability assessment determines best practices for addressing each hazard, that includes establishing warning and evacuation procedures. The assessment procedure determines how other branches of government can support resiliency and promotes outreach initiatives through mechanisms that inform the public and other government agencies (TEOP 2016). An example of this type of outreach was the Tropical Shipping and VITEMA workshop that included local government representatives, VITEMA employees, business owners and non-profit sector, and fire and police representatives.

The Tropical Shipping and VITEMA community outreach event held in April 2016 brought together participants to facilitate the exchange of best practices for business owners of local and mainland businesses, during and after a disaster. Tropical Shipping, a corporation operating out of Florida, but with shipping routes from eastern Canada to the Caribbean, co-hosted the event and focused on the importance of what they refer to as "shared ownership, leadership, and people". The facilitators underlined that in the post-disaster environment businesses and residents need to coordinate in preparation and in recovery for the whole community. They claimed to have plans in-place to support employees when a disaster occurs so they could ensure continued productivity. The VITEMA representative emphasised public-private partnerships, echoing the approach FEMA adopts when planning for disasters. As the only community outreach initiative I was able to attend, I learned from this event that both

government institutions and business owners believe that preparing for, and recovering from, disasters rests with "everyone". I found that discussion was missing regarding how to build resilience through economic and social supports in preparation for disaster events.

The assessment frameworks and mechanisms described above tended to only include local residents at a superficial level. The focus appears to be on the potential climate change and disaster impacts on local communities. The impacts include identifying vulnerabilities, such as the location of an infrastructure facility along shore lines, but these evaluation tools do not engage in the broader social-cultural context and residents' perceptions of local risks. Alternatively, social scientists evaluate risk and vulnerability with the social and cultural at the forefront, that includes determining disaster vulnerability from various perspectives, including human and ecological.

H3 Authoritative and local knowledge continue to be disconnected within disaster planning and coastal resource management

Hypothesis 3 is concerned with the disconnect between AK and LK in disaster planning and coastal resource management that exists in the U.S. Virgin Islands. This hypothesis assumes that, like the literature points out, there is a disconnect between AK and LK in these contexts. I explore this hypothesis through the variables: perceptions of disaster planning, coastal environment, climate change, demographics, AK and LK, and the different understandings of disaster planning and coastal resource management. Like the H1 section, I begin with the statistically significant results from the chi-square analysis of the surveys.

Coastal Environment & Climate Change (LK)

I grouped gender, education, and occupation into one table (Table 16) because the results for the total surveys showed each as having a significant relationship with how healthy respondent's thought their coastal environment was. Gender was significant, X^2(df=4, n=41) =

12.74, p = 0.013 (Figure 25), occupation significant, X^2(df=16, n=40) = 31.20, p = 0.013 (Figure 26), and education was significant, X^2(df=16, n=41) = 26.45, p = 0.048 (Figure 27).

Table 16. Cross Tab Analysis of Gender, Education & Occupation with Perceptions of Coastal Environment Health

Cross tab analysis of Gender, Education & Occupation with "How Healthy do You Think Your Coastal Environment is Here?"

Demographic	Profile	Very Healthy (Frequency/ Percentage)	Somewhat Healthy (Frequency/ Percentage)	Neutral (Frequency/ Percentage)	Somewhat Unhealthy (Frequency/ Percentage)	Very Unhealty (Frequency/ Percentage)
Gender	Women	1 (4%)	2 (9%)	5 (22%)	13 (57%)	2 (9%)
	Men	4 (22%)	8 (44%)	1 (6%)	4 (22%)	1 (6%)
Education	Graduate/Professional Degree	2 (14)%	2 (14%)	3 (21%)	6 (43%)	1 (7%)
	Some University	1 (8%)	2 (17%)	0	9 (75%)	0
	High School	2 (20%)	4 (40%)	2 (20%)	2 (20%)	0
	Some High School	0	1 (25%)	1 (25%)	0	2 (50%)
	Primary School	0	1 (100%)	0	0	0
Occupation	Mngmt, Business, Sciences & Arts	2 (18%)	3 (27%)	3 (27%)	2 (18)%	1 (9%)
	Service Industry	3 (19%)	1 (6%)	0	12 (75%)	0
	Sales & Office	0	0	0	1 (50%)	1 (50%)
	Natural Resources, Construction & Maintenance	0	3 (60%)	0	2 (40%)	0
	Retired	0	3 (50%)	2 (33%)	0	1 (17%)

Gender X^2 = 12.74, p = 0.013; Education X^2 = 26.45, p = 0.048; Occupation X^2 = 31.2, p = 0.013

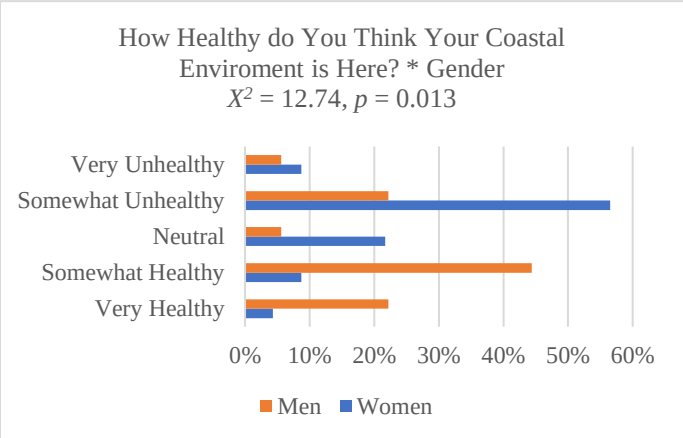

Figure 25. Graph of Perceptions of Coastal Environment Health by Gender

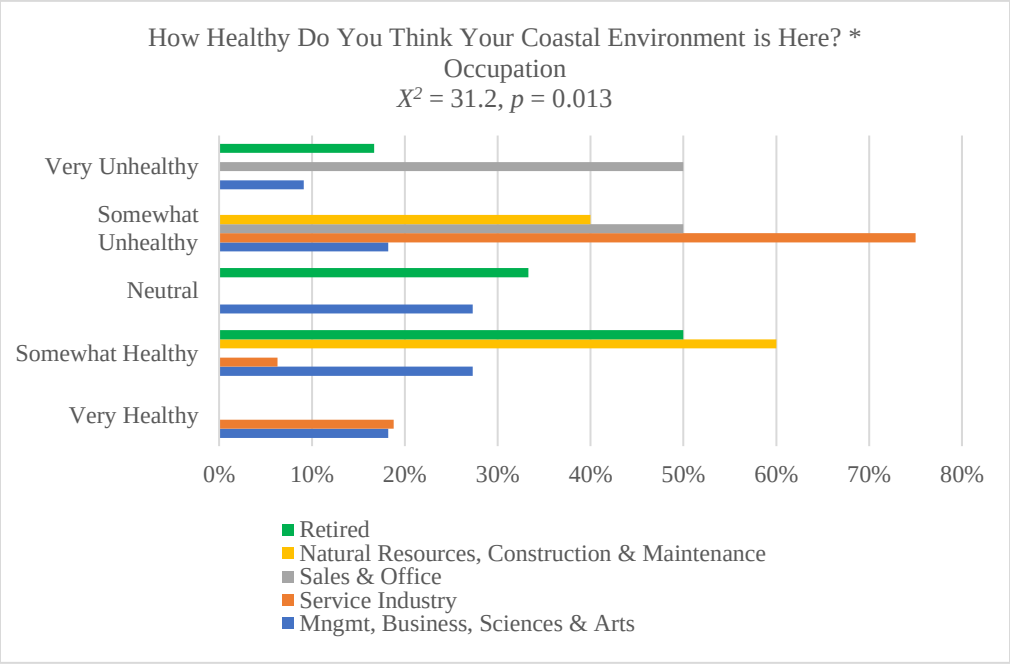

Figure 26. Graph of Perceptions of Coastal Environment Health by Occupation

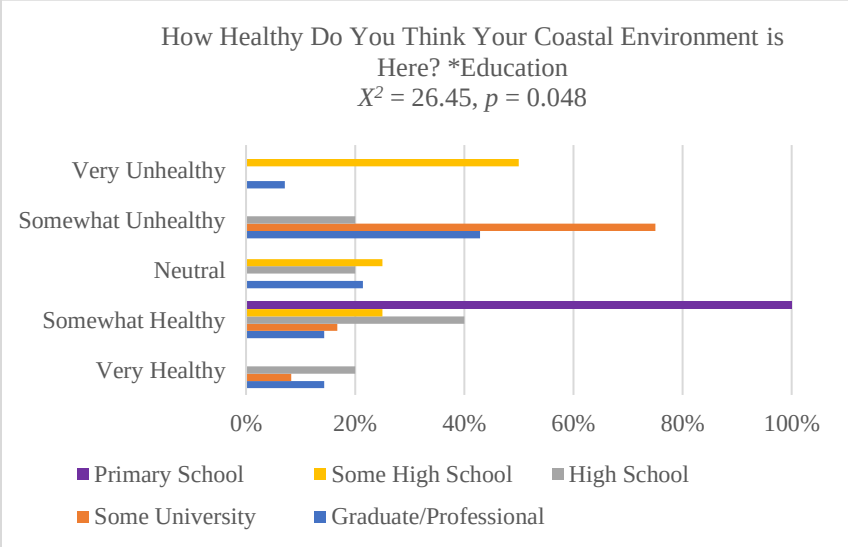

Figure 27. Graph of Perceptions of Coastal Environment Health by Education

Table 16 and Figures 25 to 27 show that for the total surveys, women working in the services industry that had a high school to university education thought the coastal environment was

somewhat unhealthy. Men working in construction, business and management or retired, with a primary school education thought the coastal environment was somewhat healthy.

Likewise, the relation between gender and what respondent's living on the east end of St. Thomas think about the health of their coastal environment was found to be significant, X^2(df=4, n=24) = 11.19, p = 0.025 (Table 17 and Figure 28).

Table 17. Cross Tab Analysis of East End Gender with Perceptions of Coastal Environment Health

Cross tab analysis of Gender with "How Healthy Do You Think Your Coastal Environment is Here?" (East End)

Gender	Very Healthy (Frequency/ Percentage)	Somewhat Healthy (Frequency/ Percentage)	Neutral (Frequency/ Percentage)	Somewhat Unhealthy (Frequency/ Percentage)	Very Unhealthy (Frequency/ Percentage)
Women	0	1 (14%)	4 (80%)	6 (86%)	2(67%)
Men	2 (100%)	6 (86%)	1 (20%)	1 (14%)	1 (33%)

X^2 = 11.19, p = 0.025

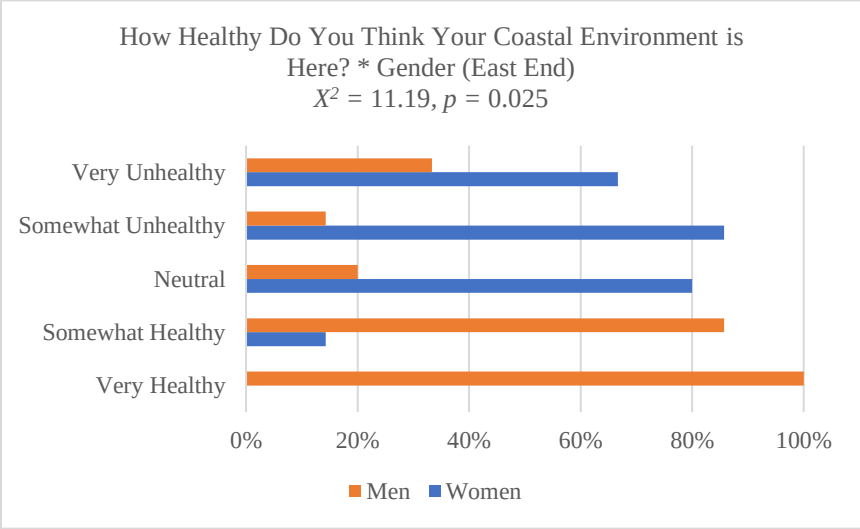

Figure 28. Graph of East End Perceptions of Coastal Environmental Health by Gender

Similar to the total survey responses to the question asking about perceptions related to coastal environmental health, for those living on the East End, gender may be a factor in how

someone understands their coastal environment. These results show that men tended to think it was somewhat healthy versus women more often perceived that it was somewhat unhealthy.

The relation between occupation and how residents living on the Northside of the island thought about the health of their coastal environment was significant as well, X^2(df=4, n=12) = 10.11, p = 0.039 (Table18 and Figure 29).

Table 18. Cross Tab Analysis of Northside Occupation with Perceptions of Coastal Environment Health

Cross tab analysis of Occupation with "How Health Do You Think Your Coastal Environment is Here? (Northside)

Occupation	Very Healthy (Frequency/ Percentage)	Somewhat Healthy (Frequency/ Percentage)	Somewhat Unhealthy (Frequency/ Percentage)
Mngmt, Business, Science, & Arts	1 (100%)	1 (50%)	0
Service Industry	0	0	7 (78%)
Natural Resources, Construction, & Maintenance	0	1 (50%)	2 (22%)

X^2 = 10.11, p = 0.039

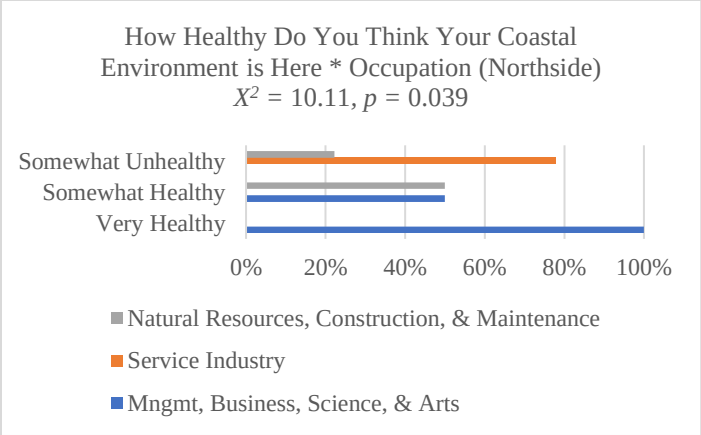

Figure 29. Graph of Northside Perceptions of Coastal Environment Health by Occupation

Perceptions of coastal environmental health on the Northside were aligned with occupation and showed that those working in the service industry thought it was somewhat unhealthy, with those working in natural resources and construction, and maintenance responded that they thought it

was somewhat healthy. The only respondent to work in management, business, science and arts thought it was very healthy.

The next series of significant results relate to perceptions of climate change. Both significant results were from respondents living on the Northside and show a relationship between occupation and climate change perceptions, X^2(df=2, n=12) = 7.20, p = 0.027 (Table 19 and Figure 30). As well, the relationship between occupation and whether the respondents think their home and work were vulnerable to climate change and disasters was significant, X^2(df=2, n=11) = 11.00, p = 0.004 (Table 20 and Figure 31).

Table 19. Cross Tab Analysis of Northside Occupation with Perceptions Climate Change

Cross tab analysis of Occupation with "Do You Think Climate Change is Impacting St. Thomas?" (Northside)

Occupation	No (Frequency/ Percentage)	Yes (Frequency/ Percentage)
Mngmt, Business, Science, & Arts	0	2 (20%)
Service Industry	0	7 (70%)
Natural Resources, Construction, & Maintenance	2 (100%)	1 (10%)

X^2 = 7.2, p = 0.027

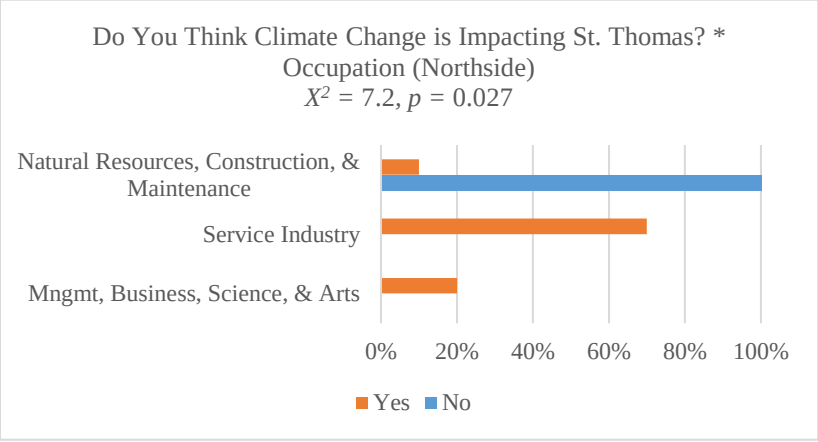

Figure 30. Graph of Northside Perceptions of Climate Change by Occupation

Table 20. Cross Tab Analysis of Northside Occupation Perceptions of Climate Change and Disaster Impacts on St. Thomas

Cross tab analysis of Occupation with "Do You Think Your Home & Work are Vulnerable to Climate Change & Disaster?" (Northside)

Occupation	No (Frequency/ Percentage)	Yes (Frequency/ Percentage)
Mngmt, Business, Science, & Arts	1 (100%)	0
Service Industry	0	7 (70%)
Natural Resources, Construction, & Maintenance	0	3 (30%)

$X^2 = 11, p = 0.004$

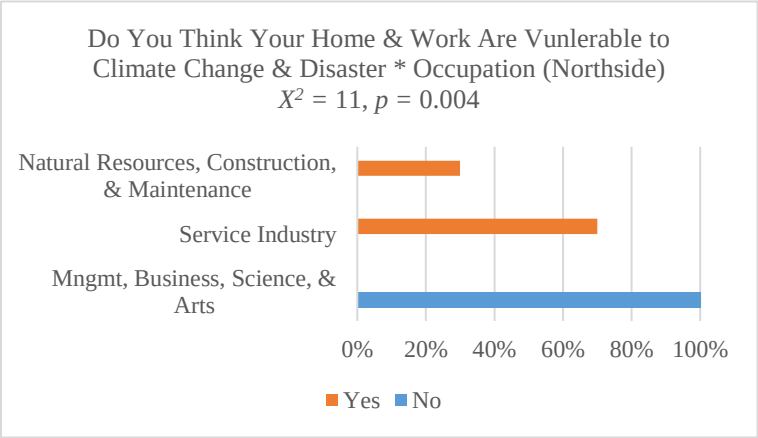

Figure 31. Graph of Northside Perceptions of Climate Change Impacts on St. Thomas by Occupation

The above results suggest that occupation may be significant when discussing impacts of climate change and disaster, but I am reluctant to rely too heavily on these results as I grouped the categories based on the U.S. Virgin Islands 2010 Census. The census categories do not necessarily capture the nuance of those responding. Two respondents who worked in the category Natural Resources, Construction and Maintenance said they did not think climate change was impacting St. Thomas. It seems unlikely that someone working in natural resources would respond that they did not think climate change was impacting St. Thomas.

Likewise, one respondent from the Management, Business, Sciences & Arts category stated they did not think their home and work were vulnerable to climate change. Upon review of the raw data from the survey responses, it appears that those who said "No" to whether they think climate change is impacting St. Thomas said "Yes" to whether they think their homes and work are vulnerable to climate change and disaster. One individual said they were a commercial fisherman and the other was a surveyor working in construction. The individual who said "No" to whether they thought their home and work were vulnerable to climate change and disaster, said "Yes" to climate change impacting St. Thomas, and said they worked as a manager, but not in what area. This suggests that there may be a divergence in how people perceive climate change and disaster, but as these results are only attributable to three individuals it is not accurate to draw general conclusions based strictly on this analysis.

Disaster Perceptions (LK)

The survey questions in this section focus on disaster perceptions that community members have regarding recovery and preparation. Analysis showed, for the total surveys, a significant relation exists between age and how well people thought their community can recover from disaster, X^2(df=16, n=41) = 44.24, p = 0.000 (Table 21 and Figure 32).

Table 21. Cross Tab Analysis of Age with Perceptions of Community Disaster Recovery

Cross tab analysis of Age with "How Well Can Your Community Recover from Disaster?"

Age	Very Well (Frequency/ Percentage)	Moderately Well (Frequency/	Not at All (Frequency/ Percentage)
18-35 Years	1 (50%)	9 (24%)	0
36-45 Years	0	7 (18%)	0
46-55 Years	1 (50%)	7 (18%)	0
56-65 Years	0	5 (13%)	0
66-75 Years	0	6 (16%)	0
76 & Over	0	4 (11%)	0
X^2 = 44.24, p = 0.00			

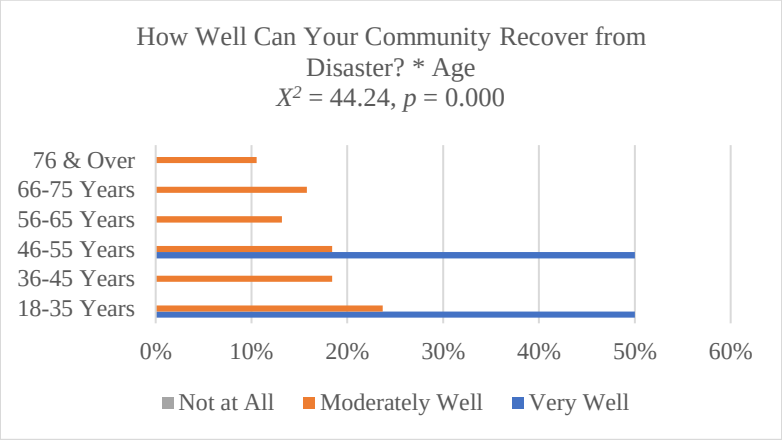

Figure 32. Graph of Perceptions of Community Disaster Recovery by Age

The above results show that a greater number of the younger respondents believe their community can recover from disaster moderately well, with progressively fewer individuals thinking that it can as the age range increases. None of the respondents thought the community would not recover at all, and only two thought it would recover very well, one from age category 18-35 years and the other age category 46-55 years. This suggests that age may be a factor influencing a person's perception of disaster recovery, and should be considered when developing projects that foster community participation in disaster planning. Additionally, it might be that younger individuals did not have the experiences and memories to draw on that influence how one perceive disasters and vulnerability.

Responses from participants living on the east end of St. Thomas showed a relation between years of residence and how well they thought their community could recover from disaster, X^2(df=2 n=24) = 8.30, p = 0.016 (Table 22 and Figure 33).

Table 22. Cross Tab Analysis of East End Years of Residence with Perceptions of Community Disaster Recovery

Cross tab analysis of Years of Residence with "How Well Can Your Community Recover From Disaster?" (East End)

Years of Residence	Very Well (Frequency/ Percentage)	Moderately Well (Frequency/ Percentage)
1 - 5 Years	0	3 (14%)
5 - 16 Years	2 (100%)	3 (14%)
16 & Over	0	16 (73%)

$X^2 = 8.3, p = 0.016$

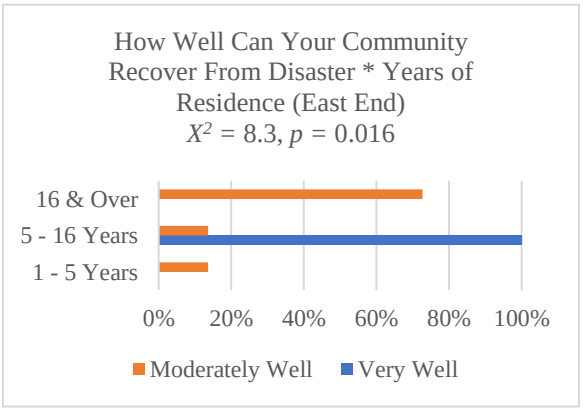

Figure 33. Graph of East End Perceptions of Community Disaster Recovery by Years of Residence

Most of the East End respondents thought their community could recover from a disaster moderately well. The only respondents to say that it could recovery very well were in the 5-16 years of residence category. These results show that years of residence might be a factor in how people think about the capacity for their community to recover.

The relationship between years of residence and how respondents living on the East End answered the question concerned with how familiar they were with what to do in a disaster was significant, X^2(df=4, n=24) = 10.71, p = 0.030 (Table 23 and Figure 34).

Table 23. Cross Tab Analysis of East End Years of Residence with Familiarity with What to do in a Disaster

Residence with "How Familiar Are You With What to Do in a Disaster?" (East End)

Years of Residence	Very Knowledgeable (Frequency/ Percentage)	Somewhat Knowledgeable (Frequency/ Percentage)	I don't Really Know (Frequency/ Percentage)
1 - 5 Years	0	2 (20%)	1 (100%)
5 - 16 Years	2 (15%)	3 (30%)	0
16 & Over	11 (85%)	5 (50%)	0

$X^2 = 10.71, p = 0.030$

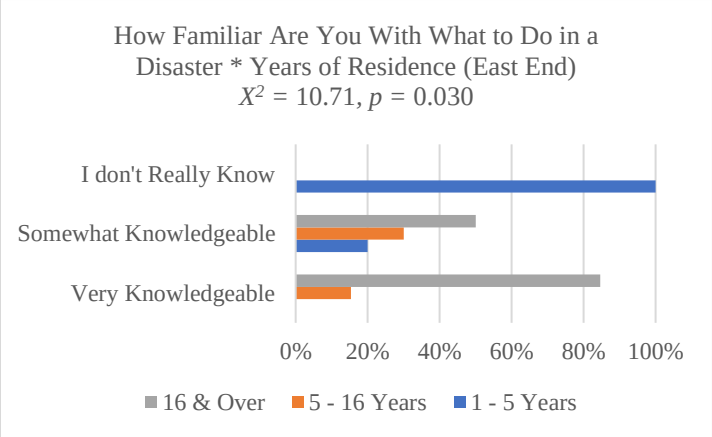

Figure 34. Graph of East End Familiarity with What to do in a Disaster by Years of Residence

The results from the analysis indicate that the respondents living on the East End of St. Thomas believed they were "Very" to "Somewhat" knowledgeable about what to do in the event of a disaster. The number of those confident they had disaster knowledge increases with the years they have resided on the island, which might be understandable considering the longer someone lives in a location can impact the knowledge they acquire through lived experience.

Responsibility Questions: Disaster Planning, Coastal Environment & Climate Change

For this section, I group perception responses in three categories: who should be responsible to come up with solutions to disaster planning, who should be responsible for

combating climate change, and who should be in charge of reducing the impacts of sewage on the coastal environment. The responses to these questions inform H3 by providing insight into how local St. Thomas residents perceive the role of the various government agencies, both federal and local, in addressing disaster planning and coastal resource management.

I organize this data by domains based on responses from the total number of respondents, by the East End respondents, and the Northside respondents. The first domain asks, "Who should be in charge of disaster planning?", has a total of 36 respondents, with 24 residing in the East End and 12 on the Northside. Respondents could select from the following list of options:

- Tourism Industry
- Individual Tourists
- The Whole USVI Community
- Individual Community Members
- VITEMA
- Non-Profit & Faith-Based Organizations
- The U.S. Federal Government
- Other Caribbean Nations
- International Organizations like the United Nations

Table 24. Opinions About Who Should Be in Charge of Disaster Planning

Who Should be in Charge of Disaster Planning? (Yes Responses)	Tourism Industry	Individual Tourists	Whole USVI Community	Individual Community Members	VITEMA	Non-Profit & Faith Based Orgs	U.S. Federal Gov't	Other Caribbean Nations	International Orgs like the UN
All Surveys	31%	17%	72%	25%	94%	19%	67%	33%	39%
East End	25%	13%	75%	13%	92%	13%	71%	33%	38%
Northside	42%	25%	67%	50%	100%	33%	58%	33%	42%

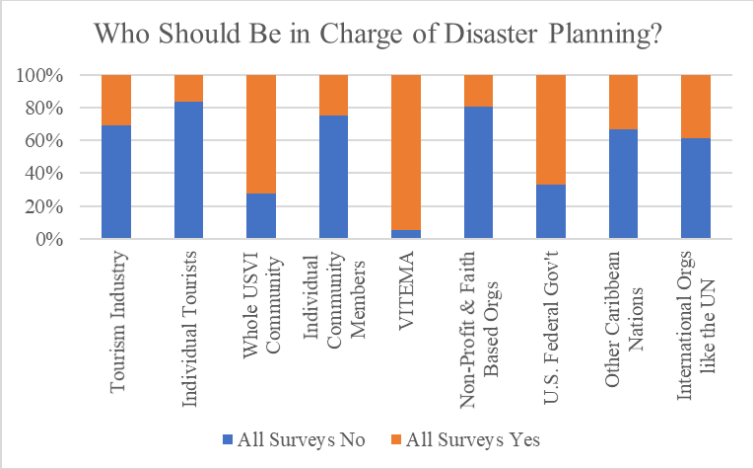

Figure 35. Graph of All Responses to Who Should Be in Charge of Disaster Planning?

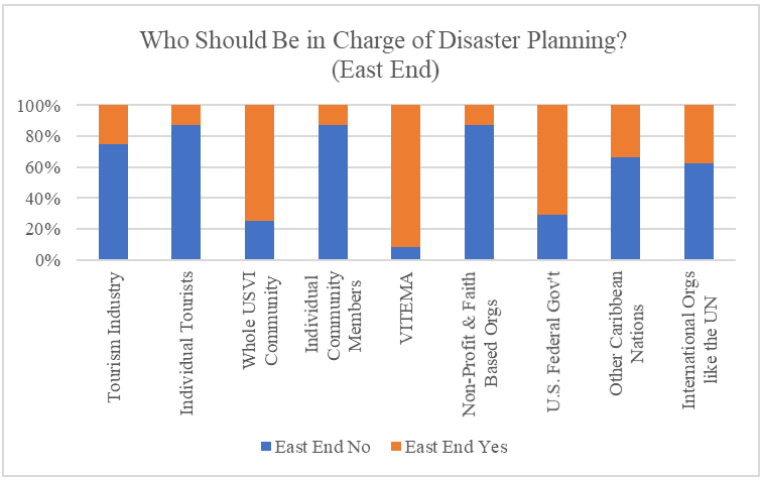

Figure 36. Graph of East End Responses to Who Should Be in Charge of Disaster Planning?

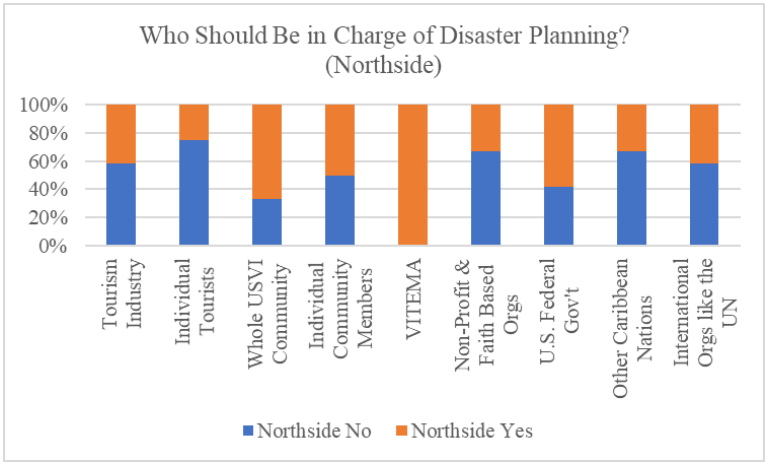

Figure 37. Graph of Northside Responses to Who Should Be in Charge of Disaster Planning?

The respondents predominantly thought the whole USVI community, VITEMA, and the U.S. Federal government should be responsible for disaster planning and more answered "yes" to these categories than the other options (Table 24; Figures 35 to 37). These results highlight that St. Thomas residents thought that local agencies like VITEMA (All Surveys 94%, East End, 92%, and Northside 100%), Federal Agencies (All Surveys 67%, East End 71%, and Northside 58%), and the entire USVI community (All Surveys 72%, East End 75%, and Northside 67%) should be responsible for disaster planning. This could suggest that there should be integration of the whole community within the policies and practices of the local and federal government agencies.

The next domain asks the question "Who should be in charge of combating climate change?", and includes total survey responses (n=33), those living on the East End (n=21), and those living on the Northside (n=12). Respondents could choose from the following list:

- Local Individual Residents
- Tourist Industry
- Individual Tourists
- The Whole USVI Community
- USVI Territorial Government
- Non-Profit & Faith-Based Organizations
- The U.S. Federal Government
- Other Caribbean Nations
- All of the Above

The majority of respondents said "Yes" to all the options with the entire community being the most selected option (All Surveys 82%, East End 86%, and Northside 75%). The fewest number of "Yes" responses were for the option "Local Individual Residents" (All Surveys 55%, East End 52%, and Northside 58%) (Table 25; Figures 38 to 40). These findings potentially mean that local residents felt that combating climate change is a substantial endeavour that will require the whole USVI community acting in conjunction with both government and non-government

institutions to create solutions, and reflects the significance of concerns about climate change that community members had at the time of data collection.

Table 25. Opinions About Who Should Be in Charge of Combating Climate Change

Who Should Be in Charge of Combating Climate Change? (Yes Responses)	Local Individual Residents	Whole USVI Community	Individual Tourists	Tourist Industry	USVI Territorial Gov't	Non-Profit & Faith Based Orgs	U.S. Federal Gov't	Other Caribbean Nations	All of the Above
All Surveys	55%	82%	61%	64%	73%	58%	76%	67%	55%
East End	52%	86%	57%	57%	71%	57%	76%	67%	52%
Northside	58%	75%	67%	75%	75%	58%	75%	67%	58%

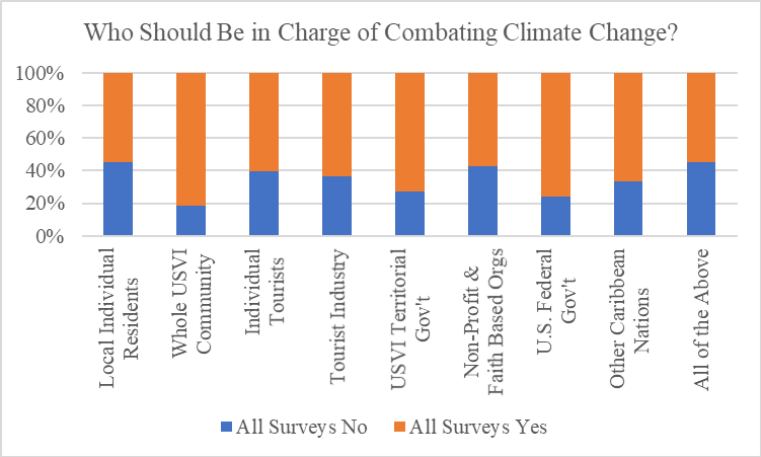

Figure 38. Graph of All Responses to Who Should Be in Charge of Combating Climate Change?

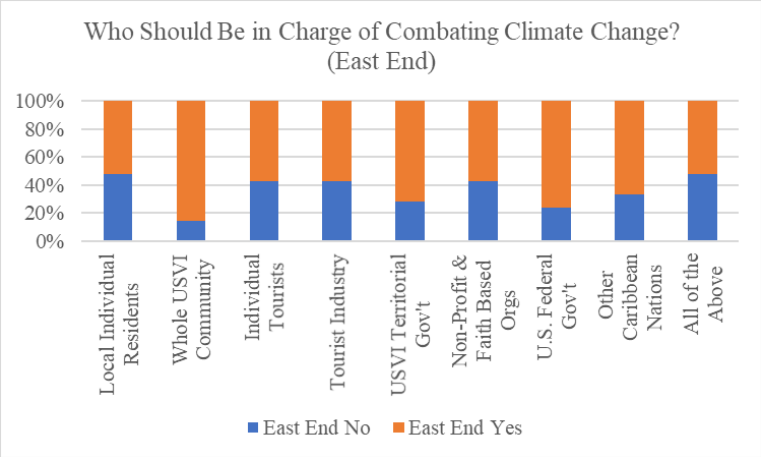

Figure 39. Graph of East End Responses to Who Should Be In Charge of Combating Climate Change?

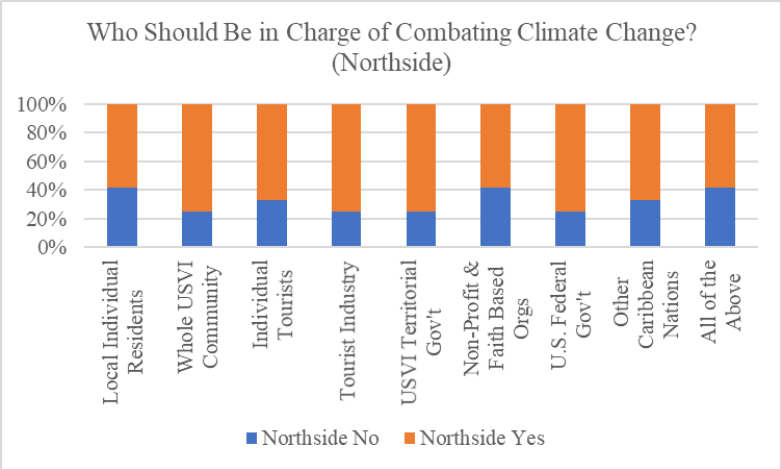

Figure 40. Graph of Northside Responses to Who Should Be in Charge of Combating Climate Change?

The last domain asks "Who should be in charge of making sure sewage doesn't hurt the coastal environment?" and includes total survey responses (n=35), those living in the East End (n=23), and those living on the Northside (n=12). Respondents could choose from the following list:

- Tourism Industry
- Individual Tourists
- The Whole USVI Community
- Individual Community Members
- VIWMA
- The U.S. Federal Government
- International Organizations
- All of the Above

More respondents said "yes" to the VIWMA (All Surveys 60%, East End 61%, and Northside 58%), the U.S. Federal Government (All Surveys 51%, Northside 42%, and East End 57%), and the Entire USVI Community (All Surveys 46%, Northside 58%, and East End 39%) being responsible for protecting the coastal environment from sewage (Table 26; Figures 41 to 43).

Table 26. Opinions About Who Should Be in Charge of Protecting the Coastal Environment from Sewage

Who Do You Think Should be In Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment? (Yes Responses)	Tourism Industry	Individual Tourists	Whole USVI Community	Individual Community Members	VIWMA	U.S. Federal Gov't	International Orgs	All of the Above
All Surveys	17%	11%	46%	14%	60%	51%	11%	11%
East End	22%	13%	39%	17%	61%	57%	13%	13%
Northside	8%	8%	58%	8%	58%	42%	8%	8%

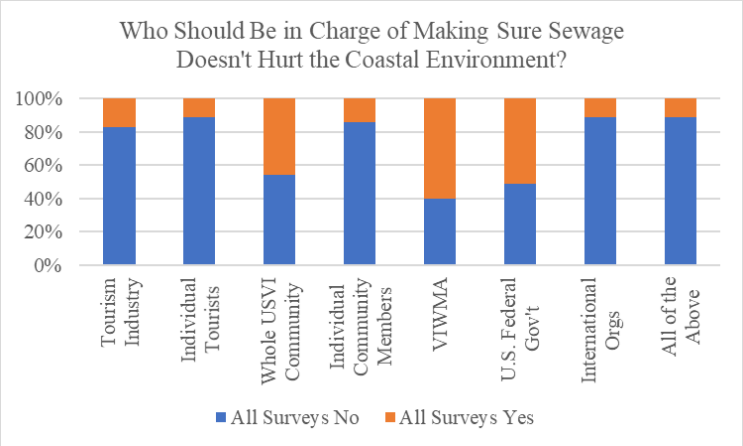

Figure 41. Graph of All Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment?

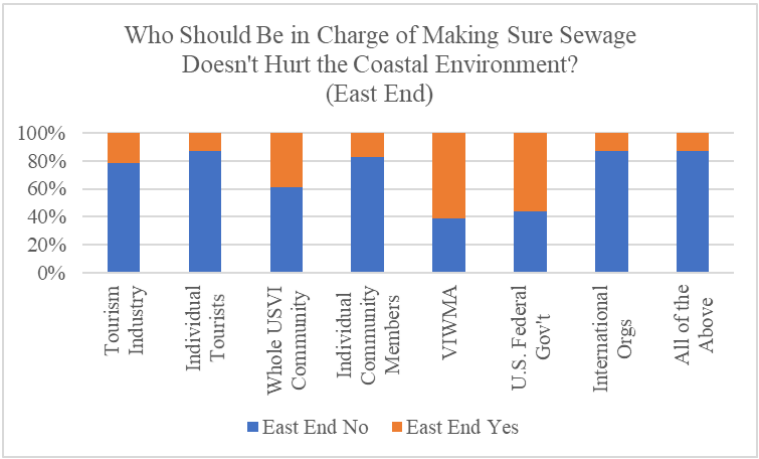

Figure 42. Graph of East End Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment?

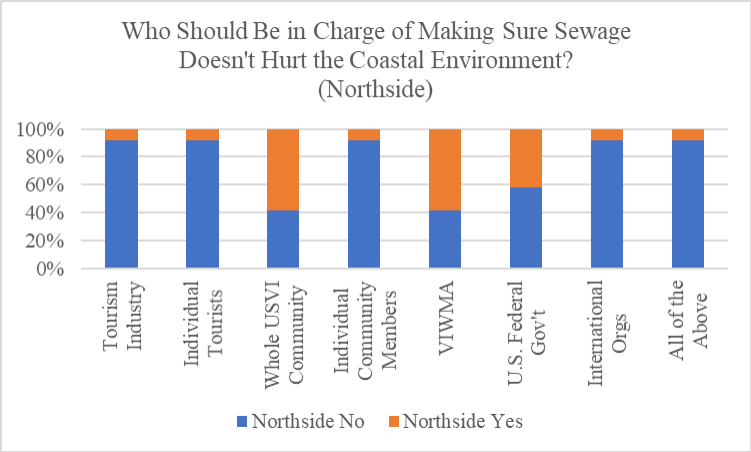

Figure 43. Graph of Northside Responses to Who Should Be in Charge of Making Sure Sewage Doesn't Hurt the Coastal Environment?

The responses to the questions described above highlight that local residents considered disaster and coastal resource management the domain of everyone living on the island and the multiple levels of government. They did not necessarily think it should be the responsibility of tourists and the tourist industry or individual community members. This suggests that there needs to be a group effort with a focus on participatory engagement with the whole community to solve problems related to disasters, climate change, and the coastal environment.

Participant Observations, Semi-structured Interviews, Focus Group & Participatory Mapping Results

This section focuses on the results from coded transcripts of the interviews and focus group, along with the participatory mapping activity. This coded data informs my H3 assumptions concerned with the disconnect between AK and LK in both disaster and coastal resource management. I utilize the Word Cloud application to provide a visual representation of these results. The transcribed interviews were coded in Dedoose, excerpts were then downloaded to a Word document and uploaded to the Word Cloud online application. Both the LK and AK word lists are the total of the word occurrence up to five times

The LK Word Cloud (Figure 44) summarizes the responses from interviews conducted with a local police officer working with the Smith Bay Watershed project, a local east end business owner and resident, two environmental organization representatives, the church choir focus group, a marine biology master's student, three northside residents who took part in the disaster mapping focus group, and two Bovoni and Nadir residents I spoke with at the local horse race track. Interview questions were designed to elicit the interviewees perceptions and knowledge related to disaster vulnerability, water, energy and wastewater infrastructure, and coastal and environmental resources on St. Thomas.

Figure 44. LK Word cloud (https://www.wordclouds.com/)

The LK Word Cloud breakdown is as follows (Table 27):

Table 27. LK Word Cloud Word Count

26	water	9	VITEMA	7	property	5	vulnerable
11	disaster	9	see	7	tsunami	5	mangroves
11	think	9	lot	7	need	5	hurricane
11	like	8	something	7	land	5	problem
10	things	8	come	7	use	5	energy
10	even	8	good	7	one	5	change
				6	community	5	money
				6	supposed	5	areas
				6	coming	5	power
				6	solar		
				6	storm		
				6	plan		

The LK Word Cloud shows the terms most respondents used when discussing their thoughts regarding the local water, power and wastewater infrastructures, disaster planning, and coastal resource health. These responses highlight that water is a prominent factor in how people thought about and perceived disaster vulnerability, water, energy, wastewater, and coastal resources. The AK Word Cloud (Figure 45 and Table 28) is produced from interviews conducted with those in positions of authority.

Figure 45. AK Word Cloud (https://www.wordclouds.com/)

Interviewees included a USVI Senator, two VITEMA representatives, one VI Waste Management representative, one Department of Planning and Natural Resources representative, and one Water & Power Authority engineer. The participants answered questions related to their specific institution or department and focused on what role they played in the community, the organization's perception of disaster vulnerability on St. Thomas, the relationship with the United States federal government and connections to the broader Caribbean region.

Table 28. AK Word Cloud Word Count

14	disaster	9	looking	7	territory	5	department
13	something	9	change	7	business	5	anything
13	need	9	water	7	climate	5	science
11	mangroves	8	vulnerability	7	right	5	working
11	know	8	concerned	7	local	5	trying
11	want	8	average	7	take	5	marine
10	one	8	citizen	7	care	5	kids
		8	happen	7	look		
		8	money	6	resources		
				6	project		
				6	little		
				6	level		
				6	Croix		
				6	start		

Some of the most prominent words to appear from the authoritative knowledge holder's interviews were: disaster, mangroves, water, vulnerability, average citizen, and money, which reflects that those in positions of authority were concerned with these factors when explaining their views of disaster vulnerability and (waste) water and energy.

A Note About the Non-Significant Chi-Square Tests

I excluded any results with a chi-square value of $p > .05$ as the test for significance was not met, but the non-significant variables and perceptions might also inform our understanding of the local water-energy nexus and disaster context. The demographics that did not have a significant connection with the perception questions were ancestry and monthly income. The perception questions that did not have a significant relationship with the demographics include how important sewage treatment was to the respondent, whether they thought the Zika virus was a disaster, whether the respondent thought their water, sewage and electricity were vulnerable to disasters, how involved the respondent had been in community disaster planning, and whether they were interested in environmental issues related to water and sanitation.

When contemplating how respondents perceived what constitutes a disaster, the Zika virus question was important because it highlights whether people think of disasters as only caused by natural hazards. In response to the question whether the Zika virus is a disaster, 56% of respondents (n=44) said “No” and 44% said “Yes”. While conducting the surveys, participants would often engage in discussion with myself and any other people that were present, and the Zika virus evoked strong opinions about what was causing and spreading the disease. There appeared to be a distrust of both governments and science in general. When I asked people whether they thought Zika was a disaster, their responses provided some interesting insight to what people think about science and scientists. Some respondents expressed that they thought Zika was emerged from the development of agricultural spraying by the scientific community, while others thought the government was dropping it from airplanes. Mostly, people thought that there was no real evidence that there was a Zika problem, and that the economic impacts on the tourism sector was more of an issue for them.

People were more concerned about Dengue and Chikungunya because of the symptoms. Some opinions were that Zika only impacts unborn fetuses and therefore does not constitute a disaster per se. Suggesting that for an event to be conceived as a disaster there is a requirement that it has an impact on large segments of a populations. Is there a way to convince people that Zika is a problem? Where is the disconnect between science and the general population? Exploring these questions might help with designing outreach and education projects.

Regarding local infrastructures, 57% of respondents (n=44) indicated that they thought their water, sewage, and electricity were vulnerable to disaster, while 33% said they thought it was somewhat vulnerable, suggesting that local residents were aware that their infrastructures were at risk if a disaster event occurred. Despite this awareness, the survey results found that

77% of respondents (n=44) were not involved in disaster planning. It would be interesting to revisit this question in the post-Irma and Maria disaster environment to see if people in the community have been more involved in disaster planning since the catastrophic 2017 hurricane season.

Having an interest in environmental issues related to water and sanitation was fairly strong at 60% of respondents (n=44), with only 8% being "Somewhat uninterested" and 10% were very "Uninterested", suggesting that most local residents were open to learning about and engaging in solutions directed at water and sanitation to reduce their impacts on the environment. As I noted at the beginning of this brief discussion on the non-significant results, although these demographics and questions were not found to have a significant relationship, they can still provide insight into what is important to local residents.

Additional Note About the Results

Despite organizing the results in defined categories based on each of my hypotheses, I note that there is a great deal of overlap between the data analysis results among the hypotheses. I present the results in relation to the hypothesis that they more closely inform, but because my research questions are interlinked, the results are also connected. This is something I explore further in the Discussion Chapter.

Chapter Summary

In this chapter I presented the results from my data analysis conducted on surveys, disaster and climate change models utilized by government agencies and a non-governmental organization, interviews, field notes, and participant observation. The results are organized by my hypotheses, beginning with H1, which states that that the USVI is at a cross-point between federal policies and practices and the local Caribbean context that it exists in. The next section

contained the results related to H2 and the analysis of CARICOM's, FEMA's, the EPA's, and VITEMA's approach to addressing disaster and climate change impacts. The H3 section describes the results related to the disconnect between AK and LK within disaster planning and coastal resource management. I concluded this chapter with a note on the importance of the non-significant chi-square results, and how the data analysis results not only inform a specific hypothesis, but they can have overlap with the other hypothesis. In the next chapter I draw on the above results, my literature review, and existing academic understandings to provide a synthesis of the data collected during my field research. The Discussion Chapter explores the current relationship between disasters, the water-energy nexus and political ecology.

CHAPTER SIX: DISCUSSION

Chapter Overview

This chapter presents the data analysis results identified in the previous chapter and explores not only the significant results from the analysis, but also contemplates the results of tests that did not produce significant correlation between demographics and questions. In addition, I work through the similarities and differences among all respondents and each region, East End and Northside. It should be noted that the following discussion is based on the understanding that the small sample size, and the limited period of time I spent in the field conducting research, does not justify generalizations to all locations, but reflects the USVI context.

Furthermore, this chapter is a discussion of my interpretation of the results and, where it is relevant, I incorporate literature and existing research, some of which is included in my literature review chapter and some that was not anticipated when I contemplated my hypotheses. The following discussion anchors and contextualizes my findings within the current academic setting concerned with the water-energy nexus, political ecology and disaster vulnerability.

Hurricanes Irma & Maria, September 2017

Returning to St. Thomas in March 2018 for the first time after hurricanes Irma and Maria was jarring. The photos on social media and in the news did not fully capture the visceral experience of being in a post-disaster environment. The island landscape had changed from the lush green I remembered, with many of the large mango trees still in the process of growing back their foliage. Additionally, at that time much of the power infrastructure was still being repaired

and replaced, with rolling blackouts still occurring frequently. I was fortunate that my Airbnb home on the east end had power throughout my stay, but many community members were not that lucky. Major institutions like the only hospital on the island were still not operating at full capacity, causing greater health and wellness concerns for residents.

During my seven-day visit, I met with some of the people that contributed to my earlier field research in 2016, and conversations involved how they were coping with the challenges of living on St. Thomas after the hurricanes. One such conversation was with my committee member, Marylin Brandt, who described how the marine sciences department building at the University of the Virgin Islands was still not usable. When I arrived on campus to present a seminar of my findings to students, professors and the public, I found Dr. Brandt and her colleagues spread throughout the available tight spaces that remained in the sociology department. It was clear that the university structures and infrastructures that were damaged during the hurricanes had not yet been fully repaired.

Discussions with other residents on the island revealed the deep frustration, and emotional and physical toil, that the post-disaster environment was having. One contributor who lived on St. Thomas her entire life described how her house was destroyed due to hurricane damage. The approval process for re-building was stymied by the bureaucratic process she was forced to navigate with the USVI DPNR. She would send the DPNR the information that they said they required, but then find out that her re-build needed to meet further requirements, which meant that she would continue to live with friends until she met the DPNR building requirements. The September 2017 hurricanes and the experiences from the March 2018 trip prompted a deeper investigation into the fractures and gaps that became more visible in the St. Thomas post-disaster environment.

"We are American citizens" was a phrase often typed on social media and voiced by U.S. Virgin Islanders in mainstream media during and after the immediate Hurricane Irma event. Many local islanders and members of the diaspora living on the U.S. mainland expressed frustration that media was not focused on the U.S. Virgin Islands both leading up to and during the period of time when the first hurricane passed over the region in early September 2017. In the media the USVI would be grouped in with all the impacted Caribbean islands. Artists and celebrities originally from the USVI were commenting publicly about the lack of recognition of the impacts of the hurricanes. Poet, Tiphanie Yanique originally from the USVI, noted in a Democracy Now! news segment that the media coverage stated the first direct hit on U.S. soil was the Florida southern coast, when in fact the first U.S. hit was the USVI (Democracy Now! September 15, 2017). What does this say about the relationship between the USVI and the U.S. mainland? The following sections explore this question in relation to my research hypothesis and data analysis results.

H1: The USVI at a Cross Point Between Federal Policies & Practices and the Local Context

H1 states that because the USVI exists at a cross point between U.S. federal policies and regulations and the broader Caribbean context, current structures follow closely the U.S. Federal programs for addressing (waste) water and energy utilities, coastal resource management, and disaster planning, but how do these programs work with uniquely local Caribbean challenges? It could be argued that challenges, such as access to funding and expertise needed to implement federal regulations, are not accounted for in federal requirements. The research question tied to H1 asks: What is the current structure of (waste) water and energy utilities, coastal resource management, and disaster planning on St. Thomas, USVI, and how can the policies related to

infrastructures work for the local context, given global-local dynamics influencing the policy process?

The results that most closely inform an understanding of the gap between local and federal policies focused on (waste) water and energy, coastal resource management and disaster planning, are those that investigated local perceptions of water, energy and wastewater infrastructures. The discussion below incorporates these results with the academic literature as a foundation for working towards a synergistic model developed to inform a critical perspective of the Building Back Better framework presented later in this chapter.

The following quote from the USVI Congressperson, Stacey Plaskett, summarizes the disconnect that is felt locally between federal policies and local realities: "Congress has a long historical record of underfunding U.S. territories. We are not asking for the world we are asking for what it'll take to get us where we should be. We are asking for the treatment that would be given to any of the 50 states. #TerritorialEquity" (USVI Congresswoman Stacey Plaskett, https://business.facebook.com/pg/repstaceyplaskett/posts/, accessed February 9, 2020). Like Congressperson Plaskett, one of the VITEMA representatives pointed out the unique challenges that exist for a U.S. territory:

> *I think about the relationship we have or do not have and I think about the financial constraints we have because we are a territory and not a state, makes us define vulnerability on our level. So, because of where we're located, because we are in the process of developing relationships, we attend conferences, attend meetings and trainings. I think because of our financial limitations, I think vulnerability meaning, almost anything that could come our way, could become problematic. So, we remain very vulnerable to any disaster because of such limitations. (VITEMA Representative #1)*

The Congressperson's and VITEMA representative's observations of the USVI geo-political realities suggest that those holding local positions of authority are aware of the unique positioning of the territory in relation to the United States Federal Government. To explore this

relationship further, I turn now to the perceptions that were found to be significant from the quantitative analysis of the data and interview responses, and how they inform an understanding of water, energy, and wastewater challenges in the USVI.

Water

The survey results that inform H1 are focused on (waste) water and energy perceptions, and begin with the question asking if the person's household conserved water and energy. The conservation behavior chi-square result was significant compared with the number of years a person had lived on St. Thomas (Table 8, Figure 16). This result is concerned with whether newcomers were engaging in water and energy conservation activities to the same extent longer term residents were. It reveals the unique USVI water and energy challenges by highlighting how residents perceive (LK holders) the local water and energy scarcity. The responses may suggest that the number of years a person has lived on St. Thomas can impact their perceptions of water and energy scarcity, possibly influencing their conserving behaviour. Crosstab analysis suggests that those who answered "yes" to conserving were more likely those living on St. Thomas for more than 16 years. Participant observation, field notes and grey literature show that most people who lived on St. Thomas were acutely aware of the high cost of energy and the scarcity of potable water.

There is a law in the USVI that requires mandatory cistern water collection for residents and businesses not on the WAPA supply lines, but cisterns often run dry due to unreliable rain patterns and droughts. Furthermore, intense rain events and hurricanes make water collected in cisterns non-potable. These factors force people to rely on water supply companies that source their water from a below ground spring, and/or they purchase bottled water, which increases the cost of accessing water. One interviewee made the comment that "De waterman de only one

making money ‘cause there’s no rain” (interview with Mary). Mary was not the only person to voice their concerns over accessing reliable and affordable water.

> *These people who own this water truck service was contributing to the flooding. When their stuff goes through the osmosis process there is excess and going into their yard…I’m not sure how many people are using their well and who might be filtration system. They may use a well for other use other than human consumption. They would still use the cistern with the trucks pump in. Washing clothes…My idea as you see, we do a lot of these town meetings, when we started it would have been good for WAPA to be accessing the wells. They could have had a substation. Another area and means to get water…For the construction they could’ve just tapped into the system. (local police officer and member of Smith Bay Flooding project)*

> *…if it rains and you have debris on your roof, if you don’t have proper covers for your cistern, all the debris goes into your cistern. Your water gets contaminated. So, you thought you had clean water but how clean is it? How do people have access to test their water to see if its clean? You are powerless. (Church Choir Focus Group Participant #1) Exactly, I can’t go down to see if my water is clean. (Church Choir Focus Group Participant #2)*

Responses to the questions asking people’s opinions about their water supply quality were significant compared with a person’s occupation, and could potentially be dependent on whether they had a cistern (rain or truck filled) or whether they had access to the water and power infrastructure (WAPA). Many WAPA customers were not happy with their water quality (claims were that it was brown in colour). One respondent noted:

> *Water quality is much worse than in the past; the water has a rust color to it and is not potable. In the past the water was great but now the quality has decreased due to new infrastructure. Rust in the water also stains clothing which then needs to be thrown out. The new system is cheaper but is not a good system. Chlorine is now added to the water which prevents filters from cleaning the rust out of the water. In the past, chlorine was not added to the water supply and the water quality was much better. Not only does the chlorine mess with the pipes but it also sickens the horses.*

An entrepreneur in Tillett Gardens also described the WAPA water as:

> *There is a lot of rust in WAPA's water (rust inhibitor). The health department will not let people filter water since a filter left in too long is more dangerous than not having a filter. The rust is a result of a rust inhibitor that is, but should not, be used.*

The above quotes from my research participants point to some of the challenges they experienced in accessing affordable and clean water for their homes, suggesting that many residents would take conserving measures to ensure their water resource goes as far as it can.

Water scarcity and poor quality can be tied to socio-economic factors in a community (Anand 2017; Johnston 1998; Zarger 1998). Who has access to a reliable water source can be influenced by where a resident lives as well as their ability to pay the high costs for access to the resource. In the case of St. Thomas, scarcity and quality are tied to whether a person lives on the northside or west end of the island as these areas receive more rainfall to fill cisterns. Another factor is whether a resident can afford to pay for either the water truck supply or WAPA desalinated water. Anthropologist, Nikhil Anand draws on the water catastrophe in Flint, Michigan to highlight the disparity in access to safe drinking water, and notes "For many, [Flint] demonstrates the raced and classed geographies of abjection, made yet again through the administration and management of infrastructures" (2017:224). The residents of St. Thomas may be entrenched in classed geographies of abjection, based on who has access and how they meet their needs for reliable sources of safe drinking water. Those who could afford to purchase potable water from non-governmental sources have reliable access to water.

Energy

Energy conserving behaviour in the Virgin Islands would often involve simply turning lights off and not turning on air conditioning units to cool homes. The electricity rates at that time of this research were as high as three times the U.S. mainland. The research participants

expressed their opinions about how difficult it was to afford the high rates and still not have reliable access to what residents refer to as "current":

> *Once it starts happening [outages], it happens very often. However, despite these issues I will pay a lot for power because I want to be comfortable and the money is not an issue. (Interview with local resident)*

> *Electricity has always been expensive here. It has declined the past year, but that is because the oil cost decreased. As you know we're switching to oil and renewable, natural gas, and that's petroleum so not too much better. It's been over a year. The last governor had the decrease by 2025 by 60%. Not quite seeing that happen. (Interview with local resident/entrepreneur)*

My own small cottage located on the hillside above Charlotte Amalie had an electricity meter attached to the larger main house on the property. I would take a photograph of the electricity meter with my cell phone and text it to my landlady. On average I was paying $50 per month, but I took pains to never use the small window air conditioning unit, and kept my lights and water (an electric pump was used to move the water from the cistern to the home – a micro example of the water-energy nexus at the household level) use to a minimum. I was able to keep my electricity costs down by making a conscious effort to reduce my consumption behaviours, but just like other residents I experienced power outages.

The results I present in the previous chapter highlight that where a resident lived and how long they lived there might have an impact on their experience with the electricity supplier (Table 9 and Figure 17). Those living on the East End and living on St. Thomas for more than 16 years responded more often that they had issues with their electricity supplier, while those living on the island between five and 16 years said they did not have issues. Education appears to be a factor for residents when accessing reliable water and energy at a reasonable price. It seems to have influenced the survey respondent's perceptions of renewable energy options. The more education a person had was related to how likely they were to "strongly agree" with renewable

energy development, but anecdotally, interview respondents noted their distrusts of the projects that have been built, exemplified by the following comments:

> *The solar systems in Donoe are very unsightly and should have been put somewhere else. New projects are great, but they need to be properly researched before they are developed. A lot of times politicians will receive money to invest in older technologies that are less efficient and that are prone to issues (Local resident).*

> *The solar panels, you take that flush large piece of land. I still want to ask someone. How are you going to take that land and put solar panels? I wouldn't mind if it was a piece of land that wasn't very useful, but not a property like that. That was a poor choice. (local police officer)*

> *There have been several proposals in terms of geothermal, in terms of new technology with…many different folks have tried to start this. They come, take what we have and go. We are a small island…I would do it myself or hire the expertise. (local Senator)*

The literature and research concerning how people perceive renewable energy projects and their willingness to support them in their community include what Mhairi Aitken (2009) argues when investigating wind farms in Scotland, is a disconnect between the community and the project development phase. Lay knowledge is still not given the level of authority that scientific or "expert" knowledge is. Despite a process of consultation that included resident's perspectives, there was more emphasis placed on the expert's knowledge in the Scottish example.

Interestingly, I observed that the legislative hearings on St. Thomas that were to determine whether three recycling bills could be passed and enacted into law did not have as many formally identified "experts" testifying. The hearings heard more testimony from local interested citizens and people from local conservation groups that did not have "scientific" backgrounds. The senate attendees at the formal hearings were more interested in hearing from

residents than “experts” in this case, and ultimately the bill banning plastic bags passed into legislation, but has been moderately implemented in the community since then.

The challenges of implementing sustainable development projects that include alternative energy solutions have been discussed in the academic literature (Bertsch et al. 2016; Colvin et al. 2016; Ince et al. 2016). This literature notes that there are different degrees of community acceptance and involvement in sustainable energy projects. Residents of St. Thomas expressed concerns about the land modifications required for the projects despite general approval of renewable energy projects at the whole community scale. Researchers investigating wind energy development in a German community also found that landscape modification had the greatest impact on whether residents accepted the project (Bertsch et al. 2016). Colvin et al. (2016) argue that higher-level approaches to community engagement that includes avoiding polarizing “voting” meetings, that utilize a third-party facilitator to reduce bias in the engagement process, and includes the local context, has greater potential to produce a project that is satisfactory for the community residents and the project developers.

From the results, one of the factors that was significant and can influence the successful adoption of renewable energy projects on St. Thomas is how long someone has lived on the island. It seems obvious that the longer you live somewhere the more you will adapt and adopt conserving behaviours, but it would be interesting to delve deeper to see how residents source information regarding conserving water and energy. What influences their choices? Is it such things as the high cost of current, the lived experiences of neighbors and friends, or local government policies? How can the local WAPA and VI Energy department better inform newly arrived residents? In turn, how can this inform local water and energy policies? Also, how are the projects developed, politically and economically? Addressing these questions has the potential to

inform the local energopower (Boyer 2014), or the political dynamics, global and local, that influence how renewable energy projects are developed in a community.

Wastewater

The precariousness of the USVI wastewater treatment systems is compounded by an aging centralized system and lack of funding. The following quote by the VI Waste Management representative captures the stress the local systems face:

> *[Funding] is either through PFA funds, which are Public Finance Authority funds, or EPA grants. Now, if you look at the extent of the wastewater systems and the amount of upgrading…it's reaching the end of its design life, a lot of these pipes, well there's a combination of materials we're using, not so much clay as is used by the U.S. Mostly it was cast iron. For awhile lots of these subdivisions used an Orange pipe which is basically asphalt and cardboard and that has been throughout the Tutu sub-divisions, which is very large. That was built by the same developer as one on St. Croix. Those are the hotspots now and causing the most problems with illegal releases. There are violations of permits because they allow open sewer when they break or bend or stop and it comes out of the manholes. We've been working on St. Croix for 5 years with just these grants. We started with 10 million dollars in grants in 2010 to now 2.5 million territory wide. The capital needed is close to 20 million a year. Anything less and you're just putting band aids on until there is a catastrophic collapse and the system stops working.*

These are the unique local challenges of developing a wastewater treatment system for a United States territory located in the Caribbean. Those managing the wastewater infrastructure struggle with patching an aging system that has segments that date back to 1997 and with limited financial resources. Making changes to the wastewater infrastructure is obstructed due to a lack of political support because of the high cost of overhauling and maintaining wastewater systems.

The survey question that asked about a person's perception of how dangerous wastewater is was significant compared with how many years they resided on St. Thomas, and was concerned with if people thought wastewater is dangerous to their health. This informs H1 by showing what residents (LK holders) perceived compared to how the authoritative entities like the Department of Planning & Natural Resources and Waste Management (AK holders) were

thinking about wastewater. Residents appeared to see a connection between wastewater and health problems, but there were several leaking septic systems on the island that could potentially impact community health. The Department of Planning and Natural Resources interviewee noted:

> *I think even if you understand the absence of the system and linking, just fixing yours, if you were to fix yours, ok what impact does that one septic system have is really that there is so many. So, there is even though personal incentive, because you're not even going to clean up your own beach you're just going to clean up 1/100th of the problem you really have to get everybody doing it to make a difference, and no one wants to spend the money to do it. Septic systems are a big problem. Another aspect of this, we don't exactly have additional blueprints of where all these things are, so a lot of the people just build their own stuff. They do it by themselves on their land. Especially if it was built before there was a lot of oversight. There is not even accurate data were everybody's septic system is. You can't even go and find each one. You would have to go property to property and GPS to get accurate data. We don't actually have that data yet. Not everyone likes you wandering around their property looking for their septic system.*

The Waste Management Authority made the following comment:

> *More and more spills will happen and then you will not see a quick death or problem, but you will see more incidences of cholera and diphtheria. Even solid waste pathogens that lead to black plague. They couldn't get rid of the rats. Everybody says yes to the importance of proper waste treatment and disposal, but no one wants to pay for it. Budget-wise it should be equal to what you would fund your fire and police department.*
>
> *Unfortunately, just as in the States, people don't see it, they flush their toilets and then they don't see it. (VIWMA representative)*

The crosstab analysis shows that the length of time a person had lived on St. Thomas might influence their perception of improperly treated wastewater as being dangerous for people. The literature does not specifically point to a connection between how long someone lives somewhere and their perceptions of wastewater, but it does show that generally demographics can influence a person's perceptions of wastewater (Robinson et al. 2005). The work of Robinson et al. that explores perceptions of wastewater recycling in the southeastern United

States, note that their results “indicate that less education, lower income, and increased age correlate with less knowledge about wastewater recycling” (2005:63), suggesting that demographics are significant when considering wastewater treatments.

Returning to the literature concerned with (waste) water, energy vulnerabilities and political ecology, it is argued that (waste) water and energy development that considers both humans and ecosystems would incorporate multivocality in the development process (Wells et al. 2014b). The critical evaluation of “who is speaking” and “who is being heard” in this process would begin to interrogate the power dynamics embedded in (waste) water and energy development. Furthermore, there should be consideration of the water-energy nexus that impacts the household level. When the current stops flowing, so does the water, either through the cistern pump or the WAPA desalination process.

H2: Risk and vulnerability: infrastructures are disconnected from historical, political, and social processes resulting in a less resilient community

H2 states that risk and vulnerability are assumed by governments and their agencies to be tied to geophysical and environmental hazards, and that they are not impacted by complex political ecological events. Likewise, infrastructures are viewed as independent, technological and scientific, and that they are disconnected from historical, political, and social processes. These perspectives of risk, vulnerability and infrastructures can result in a less resilient community by omitting the cultural multivocality that influences how a community responds to risk factors, and (waste) water and energy infrastructures. Based on these divergent perspectives I developed my second hypothesis. H2 investigates how the USVI government agencies understand “risk” and “vulnerability”, and how their understanding is similar or different to how other institutions and sciences assess them. Furthermore, this hypothesis explores how those

understandings translate into policies concerning water, energy, and infrastructures and address the hazards that contribute to disasters.

As outlined in Chapter Two, if we are to begin to address infrastructure vulnerabilities, we need to consider the relationship between cascading impacts of disasters (Tobin et al 2007), specific indicators (Jones et al. 2013) like length of time one lives on St. Thomas, as well as infrastructure vulnerabilities (Birkman et al. 2013). Wisner et al.'s PaR model argues that infrastructures and their vulnerabilities contribute to the pre-existing pressures that make communities vulnerable to disaster hazards.

As described in the quotes below, the St. Thomas wastewater infrastructures have had long-term vulnerabilities to disaster events:

> *Yeah, we looked at anaerobic digestion or even re-use of water. The problem we have on the islands is saltwater infiltration into the system. The systems are porous because of their age. Almost a tenth of our treatment is saltwater, which raises salinity basically to 7 parts per thousand. Anything above 1 part per 1000 will start sterilizing the soil. So, again that leads back to maintaining the system in order to even reduce the amount of water to process. These systems were built with combined sewers. So, separating them and getting rid of the downspouts and getting rid of the leaks - we just closed off a cross connection, remember they used to just dump out to the sea. The old existing system was cross tied, so it was just open. We had large rain events and we had more septic water because of the added downspouts and runoff. Then the sewerage would get mixed with rainwater and it would go into the ocean. But during normal times it would go to the treatment plant. So that was their emergency system of dealing with too much water. But really what you need to do is repair the systems and make them watertight. It should be a closed vessel and it should be your only inputs are the wastewater points. Like in the situation I just told you, 2 years ago we just installed flapper valves, one-way valves, which doesn't really solve the problem until all the rainwater is eliminated, but what it does is not allow rainwater to go into the system. Until all the other points of infiltration are taken care of, we have to have these emergency releases, because when you look at it, it it's sealed, then your wastewater flow is predictable. (VIWMA Representative)*

Additionally, one of the VITEMA representatives described the emergency management's understanding of what the (waste) water and energy agencies were doing regarding addressing disaster vulnerability in their systems:

> *Just a few items that came to mind that some of them are working on now in terms of waste management is there is a coastal interceptor job in St. Croix right now that's vulnerable to a disaster because of erosion and some other things. So that's one project being worked on. I saw comments on the separation of the storm and sewage systems and the vulnerability of how some of them are and how our drainage system works right now. Concerns about retrofitting of the utility infrastructure for earthquakes and that sort of thing, water generation facilities, power generation, those sorts of things. (VITEMA Representative #2)*

As noted in the previous chapter and the above quotes highlight, government institutions and private organizations tend to view infrastructures as physical structures removed from political and social processes.

The CCORAL, FEMA, EPA, and VITEMA methods for identifying disaster and climate change vulnerabilities focus on the technical and scientific understandings with minimal consideration of and integration of diverse groups in the community, and political and ecological factors. These mechanisms tend to adopt demographic and taxonomic approaches with emphasis placed on assessing human vulnerability by the vulnerability of such factors as infrastructures and health care systems. Focusing on vulnerability tied to the physical and tangible systems can contribute to the loss of complexity of local communities, and can fail to account for causation of vulnerability (Wisner 2004).

FEMA's Whole Community framework appears to recognize the gaps that the above tools have, and considers community complexity. This framework instructs that communities should be leveraging social infrastructures, networks and assets (FEMA 2011) as resources that can be operationalized to reduce disaster vulnerability.

H3 Authoritative and local knowledge continue to be disconnected within disaster planning and coastal resource management

H3 states that there remains a disconnect between authoritative and local knowledge within disaster planning and coastal resource management. The EPA OIG Audit report (2015) outlines the challenges related to environmental issues and wastewater, and the VITEMA Territorial Hazard Mitigation Plan (2014) notes the vulnerability of utility infrastructures in the U.S. Virgin Islands. These circumstances then impact policy decision-making related to water and energy utilities, coastal resource management, and disaster risk policies; potentially creating points of vulnerability. This hypothesis addresses the question: given the disconnect noted in the literature between authoritative knowledge and local knowledge in disaster mitigation planning and coastal resource management, is this the case in St. Thomas, USVI? The following sections discuss the LK and AK related to the coastal environment, climate change, and disasters.

Coastal Environment & Climate Change

The excerpt below from Edward A. O'Neill's *Rape of the American Virgins* (1972), describes the early relationship between tourism and the St. Thomas coastal environment:

> Despite the deterioration apparent to any visitor who takes time off for bargain-shopping or daiquiri-drinking to look and smell and feel, the Virgins remain glorious. But they have been ravished. And they are in trouble…on a typically lovely day in November, 1971, as soon as the skipper of the glass-bottomed boat had his mooring lines aboard, he began apologizing to his passengers-tourist…They would have to wait a bit to see the tropical fish and coral reef formation…'It's the pollution. But I'll get you out of this in a few minutes'. 'This' was the slate-grey, stinking waters of Charlotte Amalie Harbor (3-4).

I include the above quote for its impactful description of the local marine environment in 1971 and the early dynamics between local ecology and tourism.

The results from the previous chapter concerned with coastal resource management and climate change perceptions suggested gender, education, and occupation had a significant

relationship with a respondent's perceptions of their coastal environment. Respondents with higher education levels believed their coastal environment was "somewhat unhealthy", and the graduate/professional and some of those with partial high school education said it was "very unhealthy". Women tended to think that the coastal environment was "very unhealthy" to "neutral", while men expressed that they thought it was "very healthy" to "somewhat healthy". These results might indicate that gender, education, and occupation are important to consider when government agencies develop policies related to the coastal environment. Is there a way to include different groups from the community in the decision-making processes?

In this section I return to Barbara Rose-Johnston's work during the 1980s and 1990s that explored the interrelationship between the local St. Thomas community and the Caribbean environment. As noted in Chapter 2, Rose-Johnston (1987; 1994) argues that residents are disconnected from their environment due to emphasis on economic development through tourism in the 1980s and 1990s, but she recognizes in her 1994 work that efforts were emerging to create space for residents to engage more with the environment.

In the contemporary USVI, there have been steps taken to engage in knowledge sharing within the community because of the research being done by the UVI marine and environmental sciences department. The university's work related to coral reef health highlights how the impacts of impaired water quality, severe rain events, and near shore development have contributed to the degradation to the coral reefs off the coast of St. Thomas (Ennis et al. 2016). Ennis et al. 2016 recommend a focus on watershed management to reduce negative impacts on the reef systems in the territory, and the University regularly organizes opportunities for residents to participate in research initiatives that highlight the harmful impacts of development and climate change on the island waters.

During field research I participated and observed how the UVI developed citizen science programs that included local people in marine and environmental science projects. Below is a quote from a representative with the Department of Planning & Natural Resources that reflects some of the outreach they and the University were doing:

> *You don't have to get in the water. Water quality where you're on the boat taking samples, you can do microbiology, where you're looking at different aspects of these samples, but in a lab. We had one girl who would cut open a bunch of Lionfish stomachs and see what was in there. She didn't have to get in the water, she would though, but I think that's a push for some of the educational outreach. They don't have to be scuba divers, just getting them interested in science and math in general. The natural pathway for them if they are interested in science around them is mostly marine environment. They're naturally asking questions in general, getting that mindset. I think that's a big goal for the Ocean Explores. Within the same DOI grant that we just got, it was just announced a couple of days ago, the department of education put in for, and was awarded for a Stewards of the Reef Program. So, they are going to scuba certify eight kids here, and eight kids in St. Croix…They're going to go get lectures…and just target marine high schoolers, marine education for a few local kids. That's another reflection that we need to reach out and get local people more interested in the water.*

Additionally, the UVI marine and environmental sciences department would host special evenings at local restaurants and bars that featured knowledge sharing through trivia games and engaging "talks" that encouraged audience participation. I was able to attend one event that showcased the marine sciences graduate students' research findings related to an invasive seagrass that was taking over local marine habitat.

The chi-square analysis found gender and opinions about coastal health was significant. More women than men thought their coastal environment was "Somewhat unhealthy", while more men than women thought it was "Somewhat healthy". This result prompts questions asking if women are more aware of their coastal environment, or were their responses based on having a stronger opinion about it? The interview quote below expresses one individual's interest in the local coastal environment. This interviewee was a woman who grew up on St. Thomas and was

the only local representative working with the Blue Flag coastal environment certification program. The Blue Flag program classifies local waters based on their health and is a major certification recognized by the tourist industry:

> *Q: Do you see increased vulnerability to the coastal region?*
>
> *A: Yes, non-point source pollution is for us at Blue Flag a problem…certification for water and beaches. Right now, we can only have a Blue Flag season for 7 months out of the year because of poor water…none of our bays can get away from it.…It runs from December 1st to June 30th. It coincides with hurricane season. There is no control over that. That is when it is most vulnerable…November after a really big storm, that all comes down the hill. We can't stop it.…this May it wasn't that bad. This year is one of the best water quality years, because we haven't had much rain. Which is of course not great for our water table, but from a runoff standpoint alone it is less vulnerable.*

Anecdotally, and through interviews, I was often told the following when I asked the question:

> *Q: Do you think our coastal ecosystems are healthy?*
>
> *A: Yeah, healthy but could be healthier. Run-off and sewage have a negative impact on our coastal ecosystems. (local St. Thomas resident)*

Furthermore, the responses from those working in the service industry were predominantly that the coastal environment was "Somewhat unhealthy". This result is possibly influenced by the close proximity those working in the service industry have with the tourist industry and the coastal environment, which could be relevant for the local government agencies when developing policies.

Smith Bay and Water Bay Watershed Project

The Smith Bay area includes steep slopes flowing down a coastal region dominated by resorts and other tourist development. The residents of Smith Bay have been frustrated for many decades with the extreme flooding hazard they had to deal with during heavy rain events. During the rain events, sections of the low-lying coastal region are completely cut-off from the mainland areas, meaning people's homes are isolated and some are not able to get to their places of

employment. A rallying point for the community was making the Smith Bay baseball field flood resistant. The ballfield has become a symbol of making their community resilient and was the impetus for the watershed assessment project. I had the opportunity to interview one of the community leaders that pushed for the watershed project and he notes that:

> *With the Pineapple [resort], after they start to sell out to Grand Palazo was the first hotel. The original owner had been killed and the family sell out. So, they started to build. Luckily, they got the permits to fill the land. So that is how you get the first major hotel, the Grand Palazo. It had a lot of different names. They had four or five different names, but it was always a 4-star grand hotel. We had a major problem now. The water is not going to the right place, it is running down the road side. So now the next place for it to settle is the ballpark (Smith Bay Watershed Project Coordinator).*

This individual draws the connection between tourist development and the environmental consequences of flooding in local neighborhoods.

The assessment project received funding from the U.S. EPA that was funneled through the local Department of Planning and Natural Resources, and was done in partnership with a private company, Horsley Whitten. The goal was to determine where the flooding occurred and why, as well as addressing water quality impacting the coastal resources. Three stakeholder meetings were held, but only saw approximately 10 people attend, out of a community made up of hundreds of households. Ironically, one of the meetings took place during an evening of heavy rain, keeping some from attending due to high levels of water flooding roadways. Those who did attend the meetings were long-term residents who were being directly impacted by the flooding and had been the people pushing for a solution.

The watershed assessment experts taking part in the project came from predominantly engineering, soil and topography disciplines, and other watershed fields that emphasize managing the landscape and water through technical and scientific means. The stakeholder meetings were intended to help them gain the perspective of the community members, with a

participatory mapping activity that involved local people showing the project coordinators where they experienced flooding and heavy water flows on their properties. During my return trip in 2018 I learned that the project was nearing completion and was soon releasing its report. Compared to what anthropologist, Barbara Rose-Johnstone found in the 1990s, I found an increase in examples, such as the Smith Bay watershed project, of territory residents working to re-establish connections with knowledge about their local environment. Furthermore, the survey results confirm that people have concerns about the health of their environment, something that can be encouraged in government and university projects.

Disaster

The survey results from the chi-square analysis indicates a significant relationship exists among a person's perception of the ability of St. Thomas to recover from a disaster event, their age, where they lived, and the number of years they lived on the island. When it comes to disaster recovery, perceptions based on lived experience can be a factor. The below quote reflects how some individuals thought about community disaster vulnerability:

> *Q: How fast do you think the island would be able to recover from a disaster?*
>
> *A: Wouldn't take longer now since after Marilyn people now know what to do. People also come together more, even enemies become friends after a disaster until the island recovers. We all want normality. All other factors are put aside until that is achieved. However, one person does need to be in charge during a disaster and this organization is VITEMA. They can delegate tasks to everyone else. (Local Resident Interview)*

Those who lived through Hurricane Marilyn in the mid-1990s have memories to draw on, but they do not necessarily include the changes to the current local and global dynamics that influence resiliency and recovery.

Building capacity into a community can influence its pre-disaster resiliency and ability to recover from a disaster event. To address the issue of building community resiliency, I created an

adaptation of the Wisner et al. (2012) Circle of Capacity Model to fit the U.S. Virgin Islands context (Figure 46).

Local capacity is built by supporting social, economic, political, natural, physical, and human resources. Building capacity to recover from disaster events can begin with a contextual and proactive approach (Wisner 2004) that identifies groups within the community to take the lead on determining capabilities and vulnerabilities. This requires the application of the social vulnerability approach that can address power imbalances in the community, and establish a platform for integration of multiple groups in the disaster planning process. The Circle of Capacity Model emphasizes operationalizing local social networks, religious congregations, LK etc. to create opportunity to foster resiliency.

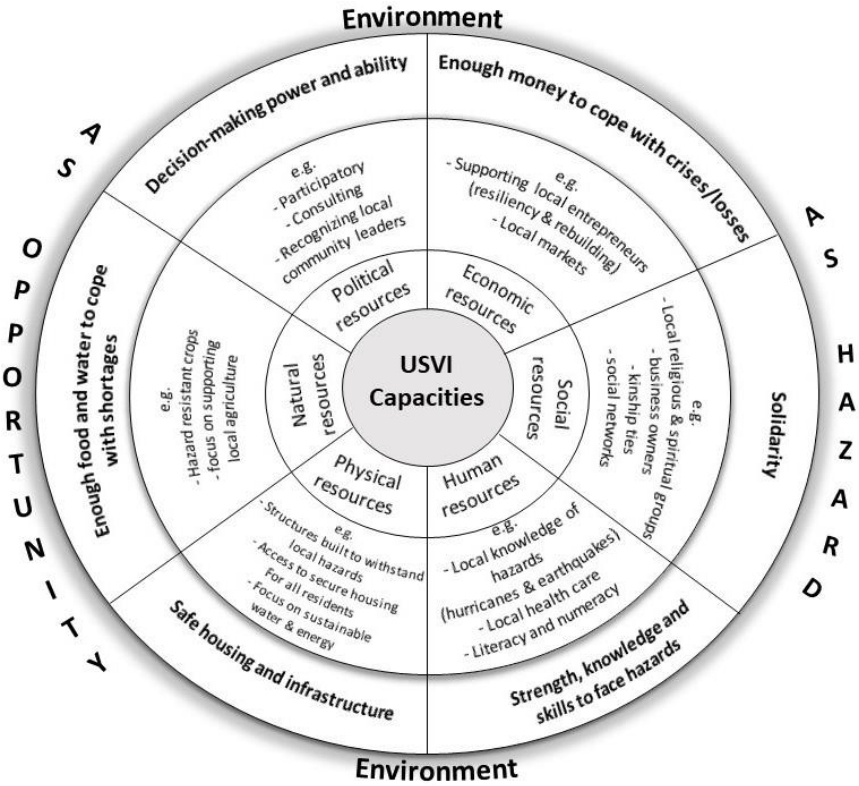

Figure 46. USVI Circle of Capacity Model adapted from Wisner et al. (2012)

This is exemplified in a comment made by a participant in the Church Choir Focus Group:

> *We do have strengths. A lot of people always have hope. There is always a hope that something will get better. What is happening, it's going to eventually get where it needs to be. I think that in the Caribbean we think of family. We look out for one another and that helps. So, when everything is happening you look out for your neighbor, and you go back to the good old days. So, you don't have WAPA but you get out some stones and a pot. A lot of us did that. We went to fish [referring to hurricane Marilyn].*

Integration of LK in the disaster planning process places value on the community members ability to evaluate and determine best practices, and draws on lived experiences to contextualize disaster resilience and recovery, but is there a mechanism to integrate LK in the disaster preparation and recovery process in the St. Thomas context?

The quote below from one of the VITEMA representatives notes that:

> *I would say that exposure is really key. If you don't travel and you're not well-read, if you stay in your little pot, you really don't care about emergency management and you really don't think it's going to affect you. Depending on the business section you're in and your day to day activities you're a part of that tells whether or not the citizen will care…Because we have nothing to fear besides hurricanes and…the organizations that will go away from the territory and are safe to face realities or have seen the effects of it come back and hold conferences like the shipping companies and the department of natural resources that does different trainings because of the business here. Yes, we can do all the things we want to public services management. If the average person doesn't feel like this can really happen to us then some times I think we are just doing things for no reason…VITEMA would stay right there and maintain their position in getting the word out that we need to be prepared. We need to take things seriously. We need to train. We need to get educated. (2016 VITEMA Representative #1)*

The second VITEMA representative that took part in the interview commented:

> *As far as the communities I've talk to, I don't think they are all that concerned about it. Maybe they are and I haven't just found them yet. I don't get that sense of concern about vulnerability. I think here, what we hear is our team will take care of it. Having a personal stake or responsibility. On the other side though also quite a few businesses and from that aspect they are concerned about vulnerability. In particular those business that rely on the sea and the coast and maritime activities. they are extremely concerned because that effects their livelihood and ability to support the territory. From that they certainly are. I mentioned before the town hall meetings as part of the development process for our current hazard mitigation plan. (2016 VITEMA Representative #2)*

The interview with the VITEMA representatives highlights the perspective of the agency that people believe that it is VITEMA's responsibility to ensure the island recovers from a disaster event. This perception was echoed by other research participants who commented that local people rely on the government for support in a disaster, and to address water and energy deficiencies.

Contrarily, VITEMA said it is simply a coordinating agency and people should be preparing in advance for a disaster. In the experience of one of the VITEMA representatives, long term local residents are less interested in preparing for disasters, while newly arrived people are more likely to contact them to find out how to prepare for a disaster. He suggested that the newly arrived residents were more concerned about preparing for disasters, while those who lived there a long time, but had not experienced a disaster, were less interested in how to prepare for one. This is somewhat conflicting with what my interviewees and participant observation with residents revealed. Most of the people I spoke with who lived there for many years were aware of disaster impacts and how to prepare for them. Does this mean that VITEMA sees/hears less regarding the long-term residents because those community members think they already know what to do? One respondent noted that he would not know what to do in the event of a terrorist attack, but would know how to survive a hurricane, having experienced two of them in the past.

The survey responses for the questions concerned with who should be responsible for combating climate change, protecting the coastal environment, and disaster planning revealed, that some people in the community thought that the whole USVI community should be in charge of addressing these challenges, but each of the local government agencies and the U.S. Federal government should also be a part of developing solutions. This prompts the question; how can

the gaps be bridged between what the government agencies are doing and what the community understands in relation to how best to promote community disaster and environmental resiliency? The answer may be that building on community engagement approaches utilized by the University of the Virgin Islands and non-profit sector to involve community members in areas of concern, such as the local ecology and environmental protections, could be effective in building community capacity.

Synthesis: Critical Assessment of the Post-Disaster "Building Back Better" Approach

During my return visit to St. Thomas in 2018 I met with one of the VITEMA representatives I interviewed during the 2016 field research. Our 2018 meeting was different than the previous one in both the meeting environment and the emotional state of mind of the individual. It was not uncommon for me to sense the heightened degree of stress and fatigue of people I spoke with while there, but it was very clear from my meeting with the VITEMA representative that this individual was feeling the weight of the recovery of the whole territory.

Our 2016 meeting took place in the VITEMA air-conditioned office building located on the southwest part of the island that most visitors, if they care to notice it, would recognize as the brick building on the corner of the intersection that leads to the airport. In 2018 we met on the street in front of a non-descript building near one of two cruise ship docks on the island. We then walked up to and into the building where there was a noticeable absence of air-conditioning and significantly less security. He informed me that this was a post-hurricane satellite location that VITEMA was using to organize a project called the Hurricane Recovery Task Force which was assigned the goal of investigating community disaster recovery. The project's focus was to assess community involvement in the recovery process, and provide recommendations to the local and

federal governments. This was just one aspect of the "building back better" phase that the Territory was developing.

Much of the post-Irma and Maria discussion has been about how to "build back better", with petitions going out to corporations like Tesla (NewEnergyEvents 2017) to provide support for new sustainable energy infrastructures such as a solar power storage system. Governor Mapp of the USVI testified before the U.S. Congress in Washington, D.C. about the desire to incorporate renewable energy solutions in the USVI. As part of his testimony was a request for federal funds to assist with developing these projects. Mapp was also in discussions with China regarding economic development, suggesting that the USVI was open to investment from foreign entities and major corporations, not just the U.S. Federal government. The question is, how does this foreign and federal investments impact the local government and community in general? What happens to the local entrepreneurs and locally sourced water and energy solutions? Figure 47 below shows an example of a renewable energy project that did not weather the storms in 2017, and was often critiqued by residents who perceived it, and other water and energy projects on the island, as exploitative and unnecessary.

Figure 47. Donoe Solar Array After Irma & Maria 2017 (Photo Credit: Maya Trotz, July 2018)

My return visit in 2018 revealed that the Emergency Management Agency and the Water and Energy Agency were entrenched in the BBB stage of recovery. Emergency Management realized that it needed to include individuals and groups from the community that others look to in times of disaster. Meetings were held to learn how best to incorporate community members in the planning process. The agency discovered that these individuals and groups were main sources of information and support for people, and that the agency should find a way to utilize them more in the future.

Additionally, WAPA was taking stock of pre-existing water and power infrastructures, while at the same time attempting to get the energy infrastructure rebuilt as quickly as possible. As a means to understanding how BBB is deployed and the potential it offers to involve community members, I created the BBB model (Figure 48). This model is designed to address my third research objective: to construct models that apply a political ecology framework that enhance community resilience in the face of identified potential water/energy disasters.

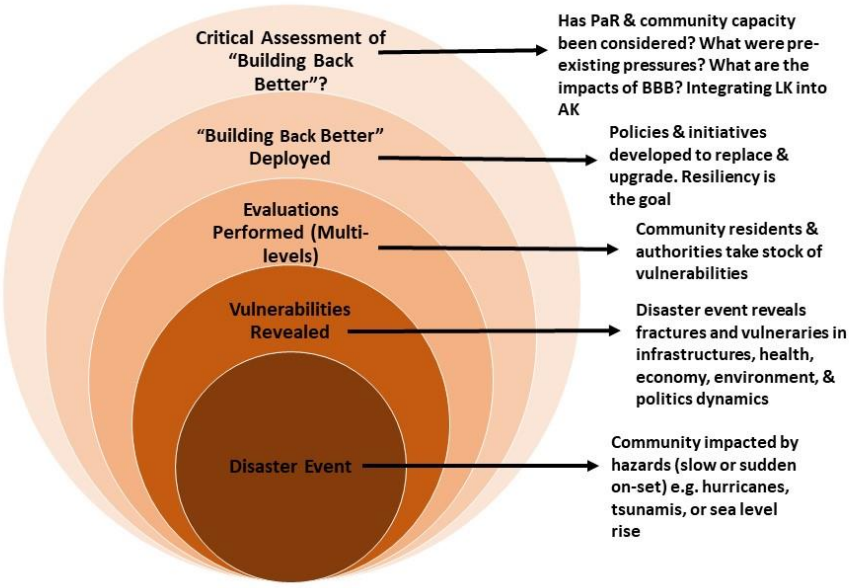

Figure 48. Building Back Better Assessment Model

The BBB model (Figure 48) draws attention to the factors and flows involved in the BBB post-disaster phase. The rippling of impacts and decisions made during this phase begin at the point of the disaster hazard event, progress through a period of realization about the community vulnerabilities with calls to evaluate and address them. These evaluations seem to be the impetus for the BBB phase, but as some note, this period should also include critical evaluation of how BBB is deployed (Di Giovanni and Chelleri 2019, Khasalamwa 2001; Wisner 2017) and the potential unintended consequences of implementing projects during this period. Questions that can inform the BBB phase include:

- How are these projects empowering the community?
- Who is part of the planning process (consultation and participation)?
- What are the funding sources for the project (governments, private sector)?
- What are the pre-existing pressures in the community that increase disaster vulnerability (wastewater, water & energy infrastructures, healthcare & agricultural systems, housing insecurity)?
- What are the existing capacities that can reduce future disaster vulnerabilities?
- How are areas in the community targeted and selected for projects?
- How do BBB projects address pre-existing socio-economic divides?

The results from the data analysis highlight that the island community is not homogenous and not everyone shares the same viewpoints or opinions about water, energy and disaster vulnerability. The emerging themes that can inform the sustainable development of (waste) water, energy and disaster include incorporating the various perspectives and opinions, and promoting transparency in the project development and implementation. Wells et al. (2019) argue that a collaborative approach to infrastructure development "can result in more normative

decisions that can lead to sustainable and equitable outcomes compared to efforts in which only a single – often scientific" – perspective is represented" (2019: 288). The Whole Community approach is a sound starting point for transparency and inclusion, but will require further development of higher-level community engagement to produce projects that ultimately meet the needs of divergent community stakeholders. A project process that incorporates pre-assessments and involves local entrepreneurs and institutions will encourage support of grass-roots solutions to infrastructure disaster vulnerabilities. Outcomes include fostering diverse economic development in the U.S. Virgin Islands and empowering local people in the governmental systems where policies are developed and enacted. Likewise, fostering interest in the science, technology, engineering, and math fields among the K-12 students in the community will encourage development of local talent that can work to develop and maintain solutions.

The findings from this research identified gaps in understandings related to disaster preparation and recovery that occurs in the BBB phase. Gaps include who should be responsible for disaster preparation and recovery. As noted above when I discuss the disaster recovery related survey results and interviews, residents see VITEMA as the primary source for disaster recovery, but these perspectives are not shared by the agency whose focus is on coordinating resiliency and recovery projects, and facilitating knowledge and information sharing. This disconnect creates a dangerous gap. When resident's perceptions do not align with a government agency, people fall though the cracks, and when those cracks are exacerbated by hurricanes and earthquakes, it can cost people's lives and livelihoods. But, how do we close these dangerous gaps?

A political-ecology critique of (waste) water, energy, disaster vulnerability and the coastal environment, as part of the BBB phase, should be asking key questions about how power

influences the economic flows in the post-disaster environment. We need to be determining how (waste) water and energy solutions are developed, who benefits from them, and how disaster recovery contracts are awarded. Where are the funds coming from and who benefits from the process? Critically investigating and tracing the money flows can reveal how decisions are being made and whose voices are prominent in the BBB phase, showing the segments of the community that are falling through pre-existing cracks. Many anthropologists have contributed to a body of literature that draws the critical gaze towards the post-disaster capitalism that arose in locations such as the country of Haiti (Earthquake in 2010) (Schuller 2012) and the city of Louisiana in the United States (Hurricane Katrina in 2005) (Gunewardena et al. 2008). It is time to turn that gaze towards the USVI and include the hydrosocial cycle framework.

Critical evaluation of the BBB phase should include interrogation of the hydrosocial cycle that includes energy as part of the water-energy nexus. Building on the arguments made by Baños et al. (2019) and McDonnell (2014) calling for the integration of energy in the hydrosocial framework, this work draws attention to the political ecology of the water-energy nexus and how these dynamics influence disaster vulnerability. In the context of the U.S. Virgin Islands, (waste) water and energy have historically been tied to developments on the United States mainland and foreign investments, which are far removed from the local Caribbean realities. How we understand the human-water-energy-environment intersection can inform how we develop sustainable solutions that address scarcity and insecurity related to water and energy. Further research of the hydrosocial cycle should include energy and how water resources intersect with humans and the environment to address the power dynamics and processes that create water and energy insecurities.

Chapter Summary

This chapter presents a discussion and interpretation of the data gathered during my research. It began with a description of the post-Hurricanes Irma and Maria environment on St. Thomas and the perspectives of USVI residents of the disconnect between the territory and the U.S. mainland. This laid the foundation for further exploration of each of the hypotheses. The H1 section presented the findings related to the themes; "water", "energy", and "wastewater". This section examined the assumption that there are unique local Caribbean island challenges that St. Thomas has as a U.S. territory when managing (waste) water and energy utilities. It concluded that data showed there are local challenges that are not addressed by the U.S. federal government agencies.

The H2 section investigated the assumption that AK views infrastructures as disconnected from historical, political and social factors. I present four models and approaches to evaluating risk and vulnerability based on the U.S. federal government agencies, the EPA and FEMA, an international institution, CARICOM, and the local St. Thomas VITEMA. This section discussed how inclusion of a broader understanding of historical, political and social processes in climate change and disaster vulnerability assessment produces more sustainable and resilient communities.

In the H3 section I examined whether AK and LK continue to be disconnected within disaster, coastal environment, and climate change management. I discuss the disconnection that exists between incorporating LK with AK in the St. Thomas context, but that there are efforts being made to re-connect, either through projects like the Smith Bay Watershed project or through the University marine and environmental sciences projects. Finally, I synthesize these findings within a model that critically evaluates the BBB approach in the St. Thomas post-

disaster recovery phase, and pose questions that can assist with guiding the BBB phase. Included is a critical discussion of the BBB phase, capital influences on the process, and the hydrosical cycle. The next chapter presents my concluding thoughts, revisits each of the research questions, and provides recommendations for filling gaps and creating bridges between LK and AK in (waste) water, energy, and disaster vulnerability management.

CHAPTER SEVEN: CONCLUSION

Returning to the BtN and the metaphor for the community's frustration with incomplete public works projects, the bridge has now been completed and the intersection traffic lights are operational (St. Thomas Source 2019), but it remains a symbol of an infrastructure project that took 20 years to complete and experienced a number of hurdles. Those hurdles did not simply cause traffic flow issues but resulted in prolonging a substantial flood hazard for the surrounding neighborhood. Despite the bridge project being completed, to date, it has not included restructuring Turpentine Run. The size of the run restricts the water flow capacity that drains down from the surrounding watershed, and has not fully mitigated the potential for catastrophic flooding. So, the anxiety must continue for those living in the Nadir and Bovoni areas. Investigating the BtN from a political ecology perspective can interrogate how these public works projects are constituted locally. The BtN as a metaphor for the BBB phase allows for a concrete example from which to launch further investigations of the power dynamics associated with the post-disaster development environment.

The U.S. Virgin Islands is not a unique location when discussing the dynamics related to risk, vulnerability and political ecology described in this dissertation. As noted in Chapter One, there are increasingly more communities impacted by disaster hazards, both sudden and slow-onset due to climate change. We can, and should, turn a critical eye to the policies and practices that our communities adopt to promote disaster resilience in response to increasing disaster hazards. Throughout this study it has been shown that the assumption that a one-response-fits-all approach can address all the complexity and divergent factors influencing disaster vulnerability

on St. Thomas. This approach misses the heterogeneity of the community that exists on the island as part of the broader Caribbean region. Is there another way to frame the issues and more sustainable solutions possible? Wells et al. (2014) suggest that dedicating further research to variables such as culture, history and power that "structure the adoption and sustainability of new technologies" (10) can contextualize initiatives within local risk and environmental perceptions.

Revisiting the Research Questions

Research Question 1

The first research question*, "What is the current structure of (waste) water and energy utilities, coastal resource management, and disaster planning on St. Thomas, USVI, and how can the policies related to infrastructures work for the local context, given global-local dynamics influencing the policy process?"* seeks to explore the political ecological context of the St. Thomas utility infrastructures, coastal resource management and disaster planning. The findings support the assumption that the U.S. federal policies were difficult to meet in the Caribbean context, leaving the Virgin Islanders vulnerable to high financial sanctions and stresses on local systems. Participant observation, semi-structured interviews, and survey results revealed that the local infrastructures, coastal resources and disaster planning are not meeting the needs of the community. Residents frequently experience power outages, unreliable access to affordable water, coastal environmental pollution from malfunctioning septic systems and aging wastewater infrastructures, and renewable energy projects that lack transparency and benefits to residents.

Research Question 2

Research question 2 asks, *"How do the local USVI government agencies understand 'risk' and 'vulnerability', and how is their understanding similar/different to how other institutions and social sciences assess them? How does that translate into policies concerning*

water, energy, and disaster infrastructures?". This question was directed at exploring how the authoritative entities in the community, and at the federal level, approach risk and vulnerability and what that meant for the water-energy nexus. The ethnographic data produced from this study shows that international institutions, federal agencies, and local agencies recognize, to varying degrees, that there is a broader context to be considered when assessing risk and vulnerability. Social processes combined with geophysical and environmental hazards create vulnerability to disasters, but there are limitations to the effectiveness of these assessment frameworks, as they fail to completely account for community multivocality in (waste) water, energy and environmental disaster mitigation strategies.

Research Question 3

Research question 3 asks, *"What is the relationship between authoritative knowledge and local knowledge in disaster mitigation planning and coastal resource management on St. Thomas, USVI?"*, and was designed to explore the dynamics that inform disaster mitigation planning and coastal resource management on St. Thomas. The political ecology theoretical framework argues that LK is not given the same authority as technical and scientific knowledge, resulting in enforced marginality in communities. Surveys with LK holders and semi-structured interviews with both LK and AK holders, showed that LK has not been fully integrated into disaster mitigation and coastal resource management on St. Thomas, but there are examples of community members pushing to re-connect with their environment and showing concern for their coastal region. The results that inform this research question emphasize the complexity of a Caribbean island community, like St. Thomas. It is a multivocal community with diverse cultural models that, if explored, can possibly be leveraged to build capacity to prepare for, and recover from, disaster hazards.

Contributions to Anthropology

This study contributes to the anthropological literature by informing the gaps identified in the introduction. It seeks to interrogate how the global is constituted locally in the Caribbean context (Grace-McCasky 2012, Mintz 1996; Trouillot 1992, Yelvington 1996) by tracing the connections between global, U.S. federal and local agencies in addressing (waste) water, energy and disaster resiliency development. It shows that the local context is important when designing sustainable development solutions that include LK in the planning process (Mercer et al. 2010). Promoting solutions at the community level, such as fostering renewable energy projects and supporting wastewater treatment plans that reduce impacts on the coastal environment, that come from within the island community allow for empowerment of marginalized groups (Wisner 2004). This research builds on the work done by Barbara Rose Johnston (1987, 1994) that contemplated the dis-connect experienced by St. Thomians from their island environment. Johnston found that inhabitants had lost local ecological knowledge due to the emphasis on economic development through tourism, but with some movement towards re-connection with their local environment. Likewise, I found instances of people seeking to regain a connection with the environment through participation in university projects and community education events, but there remains disconnections, and an area that might benefit from more research and efforts would be finding ways to make participation possible for those with limited access to transportation and other areas of the island. Socio-economics and racial tensions in the USVI might be contributing to how much people are able to prioritize the environment.

As an anthropological exploration, this research is based on a holistic approach that draws on multiple data sources. This study investigated three research questions across multiple scales and applied an analytic lens that allowed for exploration of the similarities, differences,

and synergies between LK and AK related to (waste) water, energy and disaster vulnerability. This ethnography relied on a mixture of methods that included archival research, participant observation, interviews, focus group, participatory mapping exercise, and surveys (Bernard 2011; Schensul and LeCompte 2011; DeWalt and Dewalt 2002). The ethnographic method places emphasis on perceptions and actions of those in the community, while also drawing on literature and information from written sources. Utilizing broader sources of data provide for an in-depth analysis and discussion of the research questions and hypotheses.

Recommendations

Although I situate this work in the specific St. Thomas context, there is opportunity to expand these insights to the other U.S. Virgin Islands. Each island has experienced similar impacts from Hurricanes Irma and Maria, but we might find that the outcomes are island specific. As this research found, there are different perspectives concerning (waste) water, energy and disaster vulnerability, and it would be beneficial to learn if these perspectives are similar or different in the other island communities, given their specific island cultural models. The St. Croix, St. John and Water island communities have their own histories, geographies, and vulnerabilities but form part of the whole USVI. Solutions that address (waste) water and energy vulnerabilities should be explored with island specific contexts in mind.

Moreover, this data can assist with guiding the USVI government, VITEMA, DPNR, WAPA, VIWMA, Virgin Islands Energy Department, the University of the Virgin Islands, and organizations contributing to the sustainable development of (waste) water, energy and disaster resiliency through a focus on the following recommendations:

- The USVI government can partner with WAPA and VIWMA to build in disaster mitigation for all segments of the community when it comes to (waste) water, energy and

coastal resources by coordinating to address socio-economic vulnerabilities and differential access to resources;

- Create a Standing Community Committee that works with government agencies to facilitate knowledge sharing, policy and practice development (acts as a hub between the community, utilities and VITEMA etc.);
- Government agencies and organizations should build in assessment frameworks to determine if LK is being included and disseminated between the community and its agencies;
- All entities listed above should engage in critical examination of initiatives proposed in the BBB phase of disaster recovery.

The following questions can promote further investigations that guides research concerned with (waste) water, energy, disaster vulnerability and sustainable development:

- How are post-disaster contracts awarded and how are contractors held accountable?
- Why do certain demographics from either the East End or Northside perceive disasters the way they do?
- How do people solve their (waste) water and energy needs?
- Are there more sustainable solutions that people would be willing to adopt and how can emergency management work with them to make them happen?

The preliminary findings from this work were disseminated through conference presentations at the 2016 and 2017 Society for Applied Anthropology conferences, the 2017 American Anthropological Association conference, a seminar presentation at the University of the Virgin Islands, at the 2018 Political Ecology Network conference, and at the 2018 Association of Social Anthropology conference. As well, I will develop executive summaries

and infographics directed towards a number of the stakeholders that contributed to this work, including, the USVI senator, the VITEMA representative, the Moravian church, and the DPNR.

This study contributes to the recommendations made by the United Nations Sustainable Development Goal number 11, stipulating that cities make human settlement inclusive, safe, resilient and sustainable (UN-SDGs 2018), and the WHO mandate that sustainable development of water and sanitation (WHO 2014) should be a priority of all communities. Building on the work of Anand (2017), and the anthropological understanding of political ecology and vulnerability to disaster hazards, further research should be directed towards understanding the theory of "classed geographies of abjection" in the U.S. Virgin Islands. The islands are comprised of a diverse and multivocal community, with complex neo-colonial ties to the U.S. mainland and the broader Caribbean community. The USVI setting offers the opportunity to explore how we can reduce (waste) water and energy marginality and increase disaster resilience in communities.

If we are to consider the political ecology and sustainable development study of wastewater and disaster vulnerability in the US Virgin Islands, we need to account for the long struggles of the local people for self-determination. Crucial to this research is the current human-environmental dynamics creating (waste) water, energy and disaster vulnerability. Furthermore, what are the potential unintended outcomes of the current approaches to sustainable (waste) water, energy, and disaster development that needs to be interrogated to meet the goal of creating sustainable and resilient communities.

Divergent knowledges based on cultural models that keep segments of a community apart needs a platform for integration. In the long history of anthropological scholarship, bridging gaps has been a common theme. As cultural translators, we take as our responsibility being cultural

brokers whose job it is to make the strange less so, facilitating collaboration and participation. The question is how to create the opportunity for alliance. I suggest that St. Thomas is the ideal place to explore what can be possible if (waste) water and energy policy development, and sustainable disaster planning, embraces multivocality and transparency. The outcome could be building a community that has a stronger capacity to recovery from disaster before the next storm.

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APPENDIX A: KOBO SURVEY QUESTIONS

Before the Storm: Water and Energy Utilities, Human Vulnerability and Disaster Risk
Principle Investigator: Cori Bender
Faculty Advisor: Dr. Linda Whiteford
Survey

Part I Informed Consent
Time and Date of Survey: _____
Informed Consent Script
Informed Consent to Participate in Research Involving Minimal Risk and Authorization to Collect, Use and Share Your Information

Pro # 00023933
You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.
We are asking you to take part in a research study called:
Before the Storm: Water and Energy Utilities, Human Vulnerability and Disaster Risk.
The person who is in charge of this research study is Cori Bender. This person is called the Principal Investigator. She is being guided in this research by Dr. Linda Whiteford.
This research is being sponsored by: National Science Foundation – Partnerships for International Research and Education (PIRE) program, entitled "Context Sensitive Implementation of Synergistic Water-Energy Systems" (J. Mihelcic, USF Civil and Environmental Engineering, PI).

Purpose of the study
The purpose of this study is to understand whether the current U.S. Virgin Island wastewater and energy infrastructures are able to withstand disasters as the result of natural hazards like coastal erosion and hurricanes. And, to learn how policies addressing wastewater and energy in the U.S. Virgin Islands are created. Being able to learn how wastewater and energy development occurs can help us understand how important the role of people in the local community is to the development process.

Why are you being asked to take part?
We are asking you to take part in this research study because, as a member of the local community or as a representative of an agency addressing wastewater and energy, you have insights helpful to developing our understanding of wastewater, energy, and the ability of the U.S. Virgin Islands to recover from a disaster.

Alternatives / Voluntary Participation / Withdrawal
You do not have to participate in this research study.
You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study.

Benefits
We are unsure if you will receive any benefits by taking part in this research study.

Risks or Discomfort
This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study.

Compensation
You will receive no payment or other compensation for taking part in this study.

Costs
It will not cost you anything to take part in the study.

Privacy and Confidentiality
Certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are:

- Principle Investigator
- Advising Professor
- Research Team
- National Science Foundation Partnership for International Research and Education
- The University of South Florida Institutional Review Board (IRB)

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are.
I freely give my consent to take part in this study. I understand that by proceeding with this survey
that I am agreeing to take part in research and I am 18 years of age or older.
O Yes
O No

Part II Opening Demographics
1. Do you live on St. Thomas?
O Yes
O No

2. (If yes to 1) Do you consider yourself a local of St. Thomas?
O Yes
O No

3. Where do you live on St. Thomas?

4. How many years have you lived here?
5. What type of place do you live in?
O Single story house
O Two or more story house
O Resort employee housing
O Apartment
O Other

6. If "other" for question 5 above, please specify.

7. Do you rent your house, own it, or live with family members?
O Rent
O Own
O Lives with family member

8. (If no to question 1 above): Are you here as a visitor?
O Yes
O No
O Other

9. If "other" to question 8 above, please specify.
O Cruise ship tourist
O Other tourist
O Business
O Visiting Friends and/or Family

10. If yes to question 8 above, what is the reason for your visiting St. Thomas?

Part III Waste(water) and Energy Infrastructures
11. How do you access water and power on St. Thomas?
O Cistern/Water and Power Authority
O Water and Power Authority
O Water Truck to fill cistern/Water and Power Authority
O Resort self-contained
O I don't know
O Other

12. If "other" for question 11 above, please specify

13. What is the quality of the water from your supplier?
O Very Poor
O Poor
O Good

O Very good
O Excellent

14. Are you concerned about the water quality from your supplier?
O Yes
O No

15. Have you had any issues with the water from your supplier?
O Yes
O No

16. What types of problems have you had with your water supplier?

17. How often do these types of problems occur?
O Never
O Rarely
O Sometimes
O Often
O Very often

18. How much do you pay for your water each month?

19. How do you access power/electricity?
O Water and Power Authority (WAPA)
O Solar and WAPA
O Other alternative source
O I don't know

20. Have you had any issues with the electricity from your supplier?
O Yes
O No

21. How often do these types of problems occur?
O Never
O Rarely
O Sometimes
O Often
O Very often

22. How much do you pay for your electricity each month?

23. Does your household take measures to conserve water and electricity
O Yes
O No

24. What types of water and electricity conservation measures do you use?

25. What do you think of the renewable energy projects being developed on St. Thomas?
O Agree strongly/great idea
O Somewhat agree/I have reservation
O Neutral/don't really care
O Not sure I agree
O Disagree strongly

26. How is your household sewage removed/treated?
O Waste Management Authority
O Septic tank with soakaway
O Septic tank with sand filter/soil treatment
O Direct Discharge
O Don't know
O Other

27. If "other" to question 26 above, please specify.

28. How well do you think your sewage system provides for your daily needs?
O Not well
O Well enough
O Very well
O I don't know

29. If not, what would work better?

Part IV Disaster Risk Perceptions
30. How important is treatment of sewage or wastewater to you, if at all?
O Very unimportant
O Somewhat unimportant
O Neutral/neither unimportant nor important
O Somewhat important
O Very important

31. How dangerous do you think wastewater is to people?
O Not at all dangerous
O Somewhat dangerous
O Very dangerous

32. What risk(s) does wastewater pose to human health?

33. How would you define what a disaster is?

34. Do you think the recent Zika virus should be considered a disaster?
O Yes
O No

35. What measures should you take to avoid getting the Zika virus?

36. How familiar are you with what to do in the event of a disaster?
O Very knowledgeable
O Somewhat knowledgeable
O I don't really know what to do

37. Are there many areas in your community that would be impacted by disasters?
O There are many
O There are some
O There are none

38. How vulnerable to disaster are your water, sewage, and electricity suppliers?
O Very vulnerable
O Somewhat vulnerable
O I don't know

39. How well do you think your community can recover from a disaster?
O Very well
O Moderately well
O It won't recovery at all

40. How involved have you been in the local community disaster planning and preparations?
O Very involved
O Somewhat involved
O Not involved at all

41. Who do you think should be in charge of seeing that your community can recover from a disaster
(can select more than one)?
O Tourism industry
O Individual tourists
O Whole USVI Community
O Individual community members
O VITEMA (Emergency Management Agency)
O Non-profit & faith-based organizations
O United States Federal Government
O Other Caribbean Nation Islands
O International Organizations like the United Nations

42. If "other" for question 41 above, please specify.

Part V Coastal Resource Vulnerability
43. In your view how healthy is the coastal environment here in your community?
O Very unhealthy

O somewhat unhealthy
O neutral/neither unhealthy nor healthy
O Somewhat healthy
O Very healthy

44. How important is the coastal environment to your experience as a tourist?
O Very unimportant
O Somewhat important
O neutral/neither important nor unimportant
O Somewhat important
O Very important

45. How important is the coastal environment to your experience as a community member?
O Very unimportant
O Somewhat important
O neutral/neither important nor unimportant
O Somewhat important
O Very important

46. Who do you think should be in charge of seeing that sewage is properly disposed of?
(e.g. doesn't hurt the coastal environment/reef/mangroves)?
O Tourism industry
O Individual tourists
O Whole USVI Community
O Individual community members
O VIWMA (waste management authority)
O United States Federal Government
O International Organizations
O All of the above

47. If "other" for question 46 above, please specify

48. Do you think climate change has had impacts on St. Thomas?
O Yes
O No

49. If yes to question 48, what are the impacts?
O Rising sea level
O Droughts
O Stronger storms
O Other

50. Please specify, if "other" to question 49.

51. Do you think your home and work are vulnerable to climate change and disasters?
O Yes

O No

52. If yes to question 48, who should be in charge of combating climate change?
O Local individual residents
O Whole USVI community
O Individual tourists
O Tourist industry
O USVI territorial government
O Non-profit & faith-based organizations
O United States federal government
O Broader Caribbean community (other island nations together with USVI)
O All of the above

Part VI Closing Demographics
53. What is your gender?
O Man
O Woman
O LGBQT

54. What is your age?

55. What is your ethnicity?

56. What is your nationality
O US/American
O Canadian
O European
O Other

57. If Europe, what country are you from?

58. If other, specify (what is your nationality?).

59. What is the last level of schooling you attended?
O Some primary
O Primary
O some secondary/high school (graduate)
O secondary/high school
O some university
O graduate or professional degree

60. What is your work/occupation?

61. Do you work seasonally, part time, or full time?
O Seasonally
O Part time

O Full time

62. Can you estimate your monthly income?
O 0-500 USD
O 500-1000 USD
O 1000-2000 USD
O 2000-3000 USD
O 3000-5000 USD
O 5000 or more USD

Part VII Closing
63. How would you rate your overall interest in environmental issues related to water and sanitation?
O Prefer not to answer
O Very uninterested
O Somewhat uninterested
O Neutral/neither interested nor uninterested
O Somewhat interested
O Very interested

Thank you for your time. Your responses will be combined with all the others and used to better understand local opinions about water, wastewater, energy, coastal health, and disaster vulnerability issues on St. Thomas.
Your responses will be confidential and not tied to you in any way.

[(If a resident) I am looking to recruit local residents to work together to map cultural and environmental resources that they consider vulnerable or resilient to disaster impacts on St. Thomas. Would you be interested in participating further in this study in this role?
O Yes
O Might be
O No
O Prefer not to answer

APPENDIX B: SEMI-STRUCTURED INTERVIEW SCRIPT

St. Thomas Resident Interview Guide

Date: _____

Respondent #: _____

Interviewer: _____
(If audio recording the interview, say the above information into the device)

Thank you for taking part in this interview. Your contribution is valuable and greatly appreciated. The facilitator will be asking a series of questions relating to two predominant themes: the first will be disaster vulnerability in general. The second theme is directed towards wastewater and energy in your community.

Earlier you agreed/consented to participate in this interview and mapping activity. Just as a reminder, the purpose of this study is to understand how the current U.S. Virgin Island wastewater and energy infrastructures might be impacted by disasters that happen because of natural hazards like coastal erosion, hurricanes and tsunamis. And, to learn how policies focused on wastewater and energy are created. Being able to learn how wastewater and energy development is created can help us understand the role of people in the local community in the development process.

I am asking you to take part in this research study because, as a community member you have insights helpful to developing my understanding of water, wastewater and energy utilities, and the ability of the U.S. Virgin Islands to recover from a disaster. With your consent, I will be recording this interview on a audio recording application. If you do not wish to be recorded, please feel free to indicate that and I will not take an audio recording of this interview.

1. To begin, can you tell me how long you have lived on St. Thomas and what area do you live in? Do you work here as well [if so, what kind of job do you do?]?

2. Have you experienced a disaster since your time living here (probe for how they might define a what a disaster is) [if so, can you tell me a bit about the disaster, like when it happened, where you were, and just your general experience]?

3. Can you tell me about what you should do today if a disaster happens, like a tsunami, hurricane, and the Zika virus (probe for the actions they would take and whether they think they would be safe)?

4. Are there areas and buildings that you think would be harmed during a disaster (probe for if there are certain people in your community who are more vulnerable)?

5. What do you think needs to be done to help your community during a disaster?

6. Have you taken part in any community meetings about how to make St. Thomas better able to not only withstand a disaster but also re-build after something happens?

Now I would like to ask you about your experience with getting water, energy and how wastewater is treated.

1. Can you tell me a bit about how you get your water and energy, and how your home takes care of sewage (probe for whether they are tied to the centralized infrastructures or rely on cistern and septic)?

2. If you don't mind, can you tell me how much money you spend on your utilities? Why do you think these things cost what they do?

3. Are there things you do to try to keep these costs down?

4. How about the new renewable energy projects going on around your community, do you feel they are beneficial (probe for their thoughts about costs, reliability)?

5. Have you taken part in any community meetings about the recent switch in water and energy production on St. Thomas? Do you feel that it is important for local residents to be a part of the planning process?

6. Now I would like to see whether you think your access to water, energy and wastewater treatment would be impacted by a disaster [if so, in what ways?]?

These next questions relate to your community in general and your thoughts about the health of your coastal areas.

7. Do you think your coastal areas are in good shape?

8. What does coastal health mean to you?

9. Why do people say not to go into the water at the beaches after a big rain (probe for is it because they know it is contaminated from sewage and other pollutants)?

10. What and who is a "local"?

11. Why is there so much gun violence here? Why do they think this is the case and how can it be solved? This may suggest that economic and educational opportunities seem out of reach for many young folks?

12. Why is it important to say "good morning etc." to people you see out and about (probe for why it is important here and how it create a sense of community)?

13. Does a sense of community impact disaster recovery in the long term here?

14. Do people on St. Thomas rely on each other more than local and federal government agencies during a disaster?

15. Has climate change impacted your life, and if so how (probe for short vs. long term)?

16. Do you see solutions to counter climate change?

17. How has the recent drought impacted them? Has it created extra hardship?

18. Are there some people/agencies/businesses that have more of an impact on how things get done related to climate change, water, energy, wastewater treatment and regulations?

Just to finish things up, if you are willing to share some information with me about yourself, can you tell me your age? What gender you identify as? How long you have lived on St. Thomas? And, what ethnicity you identify as?

Thank you for your time. Your responses will be combined with all the others and used to better understand local opinions about water, wastewater, energy, coastal health, and disaster vulnerability issues on St. Thomas. Your responses will be confidential and not tied to you in any way.

APPENDIX C: IRB APPROVAL LETTER

USF
UNIVERSITY OF
SOUTH FLORIDA

RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

3/16/2016

Cori Bender
Anthropology
Department of Anthropology
Tampa, FL 33620

RE: **Expedited Approval for Initial Review**
IRB#: Pro00023993
Title: Before the Storm: Water and Energy Utilities, Human Vulnerability and Disaster Risk

Study Approval Period: 3/16/2016 to 3/16/2017

Dear Ms. Bender:

On 3/16/2016, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
CBender U S V I Research IRB Protocol 3-3-2016 V1 Clean.doc

Consent/Assent Document(s)*:
Before the Storm SB Informed Consent Vs4.doc.pdf

Additional document(s):
Before the Storm SB Online (No Signature Line) Vs4.doc

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s). **Coversheets for surveys are not stamped

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review

research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(5) Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Your study qualifies for a waiver of the requirements for the documentation of informed consent for the survey as outlined in the federal regulations at 45CFR46.117(c) which states that an IRB may waive the requirement for the investigator to obtain a signed consent form for some or all subjects if it finds either: (1) That the only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. Each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern; or (2) That the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson
USF Institutional Review Board